REMARKS

Claims 1-15 are pending in the application and are at issue.

The present claims are directed to compositions and to methods of controlling a fire wherein the fire-fighting composition comprises (a) a superabsorbent polymer, (b) a colorant, (c) an *additional* opacifying agent selected from calcium carbonate and a list of specific polymers, and (d) water. The composition also can contain an optional water soluble organic solvent or other optional ingredients (e.g., claim 6). The composition imparts a color to combustible objects such that treated objects can be differentiated from untreated objects. The color imparted substantially fades within 30 days after application. Claims 14 and 15 recite specific weight ratios of colorant to opacifying agent and of opacifying agent to superabsorbent polymer, respectively.

Claims 1, 3, 6, 7, 9, 11, and 13-15 stand rejected under 35 U.S.C. §102(b) as being anticipated by Katzer U.S. Patent No. 3,354,084 ('084). Claim 2 stands rejected under 35 U.S.C. §103 as being obvious over the '084 patent. The examiner contends that the '084 patent discloses each feature of claims 1, 3, 6, 7, 9, 11, and 13-15, and that a calcium carbonate opacifying agent is rendered obvious by the '084 patent. Applicants traverse these rejections.

"Anticipation requires a showing that each limitation of a claim is found in a single reference, either expressly or inherently." *Atofina v. Great Lakes Chemical Corp.*, 441 F.3d 991, 999 (Fed. Cir. 2006). Thus, a determination that a claim is anticipated under 35 U.S.C. § 102 involves two analytical steps. First, the U.S. Patent and Trademark Office (Patent Office) must interpret the claim language, where necessary, to ascertain its meaning and scope. In interpreting the claim language, the Patent Office is permitted to attribute to the claims only their broadest *reasonable* meaning as understood by persons having ordinary skill in the art, considered in view of the entire disclosure of the specification. *See In re Buszard*, 504 F.3d 1364 (Fed. Cir. 2007) (reversing a Patent Office decision that applied an unreasonably broad interpretation to a claim); *see also, In re Morris*, 127 F.3d 1048, 1054 (Fed. Cir. 1997). Second, the Patent Office must compare the construed claim to a single prior art reference and set forth factual findings that "each and every limitation is found either

expressly or inherently [disclosed] in [that] single prior art reference." *Celeritas Techs. Ltd. v. Rockwell Int'l Corp.*, 150 F.3d 1354, 1360(Fed. Cir. 1998). Additionally, "[t]he identical invention must be shown in as complete detail as is contained in the patent claim." *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236 (Fed. Cir. 1989).

With further respect to a rejection under 35 U.S.C. §102(b), MPEP §2131 states:

> "TO ANTICIPATE A CLAIM, THE REFERENCE MUST TEACH EVERY ELEMENT OF THE CLAIM"
>
> 'A claim is anticipated only if each and every elements as set forth in the claim is found, either expressly or inherently described, in a single prior art reference.' *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987)...'The identical invention must be shown in as complete detail as is contained in the...claim.' *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989). The elements must be arranged as required by the claim, but this is not an *ipsissimis verbis* test, i.e., identity of terminology is not required. In *re Bond*, 910 F.2d 831, 15 USPQ2d 1566 (Fed. Cir. 1990)."

With respect to a determination that a claimed invention would have been obvious under §103(a), obviousness is a legal conclusion involving four factual inquiries: (1) the scope and content of the prior art; (2) the differences between the claimed invention and the prior art; (2) the differences between the claimed invention and the prior art; (3) the level of ordinary skill in the pertinent art; and (4) secondary considerations, if any, of non-obviousness. *Graham v. John Deere Co.*, 383 U.S. 1, 17-18 (1966). Secondary considerations of non-obviousness include factors such as commercial success, long-felt but unresolved needs, the failure of others, and/or unexpected results achieved by the claimed invention. *Id.* Obviousness is determined from the vantage point of a hypothetical person having ordinary skill in the art which the claimed subject matter pertains, who is presumed to have all prior art references in the field of the invention available to him/her. In *re Rouffet*, 149 F.3d 1350, 1357 (Fed. Cir. 1998). Furthermore, obviousness must be determined as of the time the invention was made and in view of the state of the art that existed at that time. *Uniroyal Inc. v. Rudkin-Wiley Corp.*, 837 F.2d 1044, 1050-51 (Fed. Cir. 1988).

The Patent Office must clearly articulate facts and reasons why the claimed invention "as a whole" would have been obvious to a hypothetical person having ordinary skill in the art at least as of the claimed invention's effective filing date. *KSR Int'l Co. v. Teleflex Inc.*, 127 S.Ct. 1727, 1741 (2007) (citing with approval In *re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006) ("[R]ejections on obviousness grounds cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness."))' see also MPEP §2143 ("The key to supporting any rejection under 35 U.S.C. §103 is the clear articulation of reason(s) why the claimed invention would have been obvious.").

To reach a proper determination under 35 U.S.C. §103(a), the examiner must step backward in time and into the shoes worm by the hypothetical "person of ordinary skill in the art" when the invention was unknown and just before it was made. In view of all factual information, the examiner must then make a determination whether the claimed invention "as a whole" would have been obvious at that time to that person. Knowledge of applicants' disclosure must be put aside in reaching this determination, yet kept in mid in order to determine the "differences," conduct the search, and evaluate the "subject matter as a whole" of the invention. The tendency to resort to "hindsight" based upon applicants' disclosure is often difficult to avoid due to the very nature of the examination process. However, impermissible hindsight must be avoided and the legal conclusion must be reached on the basis of the *facts* gleaned from the prior art. MPEP §2142.

Furthermore, to establish a prima facie case of obviousness, the examiner must satisfy three requirements. First, as the U.S. Supreme Court very recently held in *KSR International Co. v. Teleflex Inc. et al.*, 127 S.Ct. 1727 (2007), "a court must ask whether the improvement is more than the predictable use of prior art elements according to their established functions. ...it [may] be necessary for a court to look to interrelated teachings of multiple patents; the effects of demands known to the design community or present in the marketplace; and the background knowledge possessed by a person having ordinary skill in the art, all in order to determine whether there was *an apparent reason* to combine the known elements in the fashion claimed by the patent at issue. ...it can be important to *identify* a *reason that would have prompted a person of ordinary skill in the relevant field to combine*

the elements in the way the claimed new invention does... because inventions in most, if not all, instances rely upon building blocks long since uncovered, and claimed discoveries almost of necessity will be combinations of what, in some sense, is already known." (emphasis added, *KSR*, *supra*). Second, the proposed modification of the prior art must have had a reasonable expectation of success, determined from the vantage point of the skilled artisan at the time the invention was made. *Amgen Inc. v. Chugai Pharm. Co.*, 18 USPQ2d 1016, 1023 (Fed. Cir. 1991). Lastly, the prior art references must teach or suggest all the limitations of the claims. In *re Wilson*, 165 USPQ 494, 496 (C.C.P.A. 1970).

As recently articulated by the Court of Appeals for the Federal Circuit in *Ortho-McNeil Pharmaceutical Inc. v. Mylan Laboratories Inc.*, 86 USPQ 2d, 1196, 1201-2 (Fed. Cir. 2008):

> "As this court has explained, however, a flexible TSM test remains the primary guarantee against a non-statutory hindsight analysis such as occurred in this case. *In re Translogic Tech., Inc.* 504 F.3d 1249, 1257 [84 USPQ 2d 1929] (Fed. Cir. 2007) ("[A]s the Supreme Court suggests, a flexible approach to the TSM test prevents hindsight and focuses on evidence before the time of invention.)."

Once the Patent Office properly sets forth a prima facie case of obviousness, the burden shifts to the applicants to come forward with evidence and/or argument supporting patentability. *See In re Glaug*, 283 F.3d 1335, 1338 (Fed. Cir. 2002). Rebuttal evidence is merely a showing of facts supporting the opposite conclusion." *In re Piasecki*, 745 F.2d 1468,1472 (Fed. Cir. 1984). Evidence rebutting a prima facie case of obviousness can include: (a) "evidence of unexpected results," *Pfizer, Inc. v. Apotex, Inc.*, 480 F.3d 1348 1369 (Fed. Cir. 2007); (b) "evidence that the prior art teaches away from the claimed invention in any material respect," *In re Peterson*, 315 F.3d 1325, 1331 (Fed. Cir. 2003); and, (c) evidence of secondary considerations, such as commercial success or long-felt yet unmet needs, *WMS Gaming, Inc. v. International Game Tech.*, 184 F.3d 1339, 1359 (Fed. Cir. 1999). The Patent Office must always consider such evidence supporting patentability. *See, e.g., In re Sullivan*, 498 F.3d 1345, 1352-53 (Fed. Cir. 2007) (reversing a Patent Office decision of obviousness because the Patent Office failed to consider the applicants' evidence rebutting a prima facie case of obviousness because the Patent Office failed to consider the applicants' evidence

rebutting a prima facie case of obviousness). If the Patent Office determines that such evidence is not compelling or is insufficient, then the Patent Office should specifically set forth the facts and reasoning supporting that determination. MPEP §2145 (8^{th} Ed., Rev. 6, Sept. 2007).

The '084 patent discloses fire fighting compositions that contain a water-swellable acrylic polymer, an inorganic solid, and water. The composition also may contain a colorant. The water-swellable acrylic copolymers of the '084 patent are polyacrylamides (column 2, lines 33-59) or other water-swellable polymer (column 4, lines 34-52). Contrary to the assertion of the examiner, the '084 patent does *not* disclose mixtures of a water-swellable polymer with an additional opacifying polymers, such as those recited in element (c) of claims 1 and 11.

In particular, claims 1 and 11 require an additional opacifying agent selected from calcium carbonate (also claim 2) and various polymeric opacifying polymers (also claim 3). The examiner relies upon column 4, lines 34-53 of the '084 patent for teaching the additional polymeric opacifying agents recited in claims 1 and 11. The examiner misreads this portion of the '084 patent.

Column 4, lines 33-52 of the '084 patent states:

> "In addition to the aforementioned water-swellable acrylamide copolymers, other water-swellable acrylic polymers useful herein include interpolymers of alkali metal acrylates and methacyrlates reacted with a lightly cross-linking amount of a diethylenically unsaturated monomers copolymerizable therewith or cross-linking high energy ionizing radiation. *Also useful are lightly crosslinked polymers such as the above containing optional minor proportions, e.g., 0 up to 40 percent by weight or so of other monomers copolymerizable with sodium acrylate or acrylamide.* Suitable optional comonomers for the preparation of such interpolymers include N-vinyl-2-oxazolidinone, N-vinyl-pyrrolidone, sodium styrene sulfonate, potassium sulfoethyl acrylate to mention a few suitable water-soluble comonomers. Particularly preferred are essentially non-ionic and anionic comonomers. Also essentially water-insoluble comonomers can be used, such as styrene, methyl acrylate, ethyl methacrylate, acrylonitrile, vinyl acetate and the like." (emphasis added)

This paragraph of the '084 discloses *other* water-swellable polymers that can be used *in place of* a polyamide homopolymer. Contrary to the contentions of the examiner, the 0-40% of other *monomers* disclosed in the above paragraph does *not* relate to 0-40% of a second or additional polymer used together with the polyacrylamide, but to *monomers* that can be copolymerized with acrylamide to provide an acrylamide copolymer.

The present claims recite an *additional* copolymer or calcium carbonate that is present in the fire-fighting composition in addition to the superabsorbent polymer. It should be further noted that the polymers of the claimed additional opacifying agent (and calcium carbonate) are not superabsorbent polymers.

Therefore, a difference exists between the present claims and the '084 patent, and on this basis alone, the '084 patent cannot anticipate the present claims under 35 U.S.C. §102(b).

In addition, the '084 patent discloses the use of a finely divided solid to decrease the mobility of a swollen gel, increase viscosity, and increase opacity ('084 patent, column 1, lines 54-59). Importantly, the finely divided solid stabilizes the polymer gel against light induced degradation.

At column 2, lines 1-21, the '084 patent discloses finely divided solids that can be used. The '084 patent discloses various finely divided solids at column 2, lines 3-5, including lead carbonate and calcium silicate. The examiner contends that the '084 patent teaches or suggests calcium carbonate because the reference discloses "silicate and carbonate metals of calcium and lead". This contention is incorrect.

The '084 patent teaches specific finely divided solids, and that the solid should be non-ionic, as defined in the '084 patent, column 2, lines 5-12, i.e., a resistivity of at least about 50,000 ohms for a slurry containing 0.2 weight percent of the solid, or else effective gel capacity of the polymer will be "substantially diminished" (column 2, lines 10-12). As discussed below, calcium carbonate fails to meet this '084 patent definition of a finely divided solid. Furthermore, the '084 patent fails to contain any generic disclosure with respect to

either carbonate and silicate or lead and calcium, or that the anions and cations of the compounds disclosed at column 2, lines 1-5 can be mixed and matched.

In summary, it is submitted that a difference exists between the '084 patent and claims 1, 3, 6, 7, 9, 11, and 13-15 because the '084 patent fails to teach *each* of a superabsorbent, colorant, additional polymer or calcium carbonate opacifying agent, and water. Therefore, the rejection of claims 1, 3, 6, 7, 9, 11, and 13-15 as being anticipated by the '084 patent under 35 U.S.C. §102(b) should be withdrawn. It also is submitted that these claims, and claim 2, would not have been obvious over the '084 patent. In particular, the examiner *incorrectly* contends that specific inorganic solids disclosed in the '084 patent are only "illustratively" named and that any similar solid would suffice (Office Action, page 4).

First, in order to establish a *prima facie* case of obviousness, the cited art must disclose or suggest each element recited in the claims. As discussed above, the '084 patent fails to teach or suggest an additional polymer that is present as an opacifying agent. The '084 patent teaches acrylamide homopolymer and other *water-swellable* acrylic polymers, including acrylamide copolymers, that can be used in place of polyacrylamide.

In addition, the '084 patent provides no apparent reason for a person skilled in the art to modify the '084 patent disclosure and include an additional opacifying polymer, as presently claimed. The '084 patent cannot provide any reason, incentive, or motivation for a modification to include an additional polymeric opacifying agent because the '084 patent is totally silent with respect to additional polymeric agent in the composition.

In summary, the '084 patent fails to teach or suggest an additional opacifying polymer, that, as claimed, is *not* water-swellable. Accordingly, the '084 patent cannot render the present claims obvious.

With respect to the recitation of calcium carbonate as the additional opacifying agent in claims 1 and 2, applicants submit that a substitution of calcium carbonate for the lead carbonate or calcium silicate disclosed in the '084 patent, in view of the definition given in the '084 patent for a finely divided solid, would not have been an obvious substitution.

Further, the '084 patent discourages, and leads persons skilled in the art away from, such a substitution.

The '084 patent discloses "finely divided, opaque and essentially non-ionic solids" (column 2, lines 1-2). As stated above, a "non-ionic solid" is defined in the '084 patent as one having a resistivity (of a 0.2 wt.% aqueous slurry) of at least about 50,000 ohms. Compounds that are salts composed of cations and anions fall under the term "non-ionic" because of the identity of compounds listed at column 2, lines 2-5 of the '084 patent. In fact, the term "non-ionic" in the '084 patent apparently is equivalent to "insoluble" in water because a soluble salt would exhibit an ionic conductivity and, in turn, a lower resistivity than *required* by the '084 patent. As stated above, a finely divided solid having a resistivity less than about 50,000 ohms adversely affects results (see '084 patent, column 2, lines 10-12).

The attached Exhibit A contains water solubilities for many of the finely divided solids disclosed in the '084 patent. Exhibit A contains data from the "Handbook of Chemistry and Physics," 51st edition, (1970) R.C. Weast, ed. and "The Merck Index," Ninth Edition (1976) M. Windholz et al. eds. It should be noted that lithopone ('084 patent, column 2, lines 3-4) is a mixture of barium sulfate and zinc sulfide, each of which is water insoluble, as shown in Exhibit A. As known in the art, powdered aluminum, diatomaceous earth, and silica gel have no water solubility. Exhibit A also contains the water solubility for the claimed calcium carbonate.

With respect to calcium silicate mentioned by the examiner, calcium silicate is insoluble in water, whereas calcium carbonate has a finite, but low, solubility (0.00153 g/100 ml or 0.0014 g/100 ml at 25°C for aragonite and calcite, respectfully, Exhibit A). On its face, this difference in solubility appears inconsequential, but this difference in solubility has practical ramifications. For example, for water contact construction purposes, portland cement mortar (which is in essence calcium silicate) is used rather lime mortar (which is in essence calcium carbonate) in order to impart sufficient water insolubility to the end product.

With respect to lead carbonate, lead carbonate (cerrusite) has a solubility of 0.00011 g/100 ml at 20°C (Exhibit A). Even disregarding that the atomic weight of lead is five times of calcium (which would reduce the ionic conductivity of a solution of the same

concentration in terms of mass even further) lead carbonate is one order of magnitude (i.e., 10 times) *less* soluble than calcium carbonate. Further, from the subject matter of the '084 patent, it can be inferred that the '084 patent is not referring to cerrusite, but basic lead carbonate ("white lead," mankind's oldest white pigment), which is insoluble in water. Consequently, the '084 patent disclosure is directed to highly insoluble (i.e., high resistivity), water insoluble solids, and calcium carbonate is excluded from this definition because its water solubility is too great.

The '084 patent teaches that the finely divided solids imparts definite properties to the composition. The '084 patent discloses the use of an insoluble solid to stabilize the water-swellable polymer against degradation by sunlight, which in turn maintains gel viscosity for a longer time. Titanium dioxide, a known white, insoluble solid, performs the best by far in this regard. Accordingly, there is no incentive or apparent reason for a person skilled in the art to substitute a substantially more water soluble calcium carbonate for an insoluble solid disclosed in the '084 patent with any reasonable expectation of successfully maintaining gel viscosity.

The '084 patent therefore fails to teach or suggest every claimed element. The '084 patent disclosure is limited to highly insoluble solids having a resistivity of at least about 50,000 ohms for a 0.2 weight % dispersion. Calcium carbonate does not fall within this definition, and accordingly, is neither taught nor suggested by the '084 patent. To the contrary, the '084 patent discourages, and even leads skilled persons away from, the use of calcium carbonate in a composition of the '084 patent (see '084 patent, column 2, lines 10-12). A *prima facie* case of obviousness therefore cannot be maintained.

In summary, it is submitted that claims 1, 3, 6, 7, 9, 11, and 13-15 would not have been obvious over the '084 patent for all the reasons set forth above, and that the rejection of claim 2 under 35 U.S.C. §103 as being obvious over the '084 patent should be withdrawn.

Claims 4-6, 12, and 13 stand rejected under 35 U.S.C. §103 as being obvious over the '084 patent in view of Tanaka et al. U.S. Patent Publication No. 2002/0014610 ('610). Applicants traverse this rejection.

The patentability of the claims over the '084 patent has been discussed above. The '610 publication does not overcome the deficiencies of the '084 patent. The '610 publication relates to a different fire extinguishing mechanism than the present application. The presently-claimed *high-viscosity* superabsorbent gels maintain a quantity of water close to a combustible object, such as a house with a wildfire approaching. Opacity and color help fire fighters recognize whether the object is protected from a distance (such as from a fire-fighting plane). During a fire, the water evaporates, removes heat, and prevents burning of the object. If untouched by fire, the composition slowly dries and degrades. In short, a claimed composition is a fire-prevention composition.

In contrast, the '610 publication discloses a stable *low-viscosity* (see paragraph [0106]) composition that can be stored in a fire extinguisher and applied, as a foam, to extinguish a fire. The '610 publication therefore discloses a fire fighting composition (applied after fire ignition), which is different from a fire prevention composition (applied prior to fire ignition). In the '610 publication, a fluorine-based surfactant is combined with a water-soluble high molecular weight material (paragraphs [0008] and [0037] to [0087]). The '610 publication discloses polyethyleneimine as a water-soluble high molecular weight material for use *with* the surfactant and "a polybasic acid compound (C)" to "improve flame resistance and fuel resistance" ('610 publication, paragraph [0088]). Opacity is not an issue in the '610 patent, and is neither addressed nor considered.

Persons skilled in the art are aware of differences between fire prevention compositions and fire extinguishing compositions, and compounds used in one of the compositions for a particular function are not automatically used in the other type of composition. There simply is no apparent reason for a person skilled in the art to use a polyethylenimine of the '610 publication (in the absence of fluorinated surfactant and polybasic acid complex) directed to fire extinguishing compositions in a present fire prevention composition.

With respect to the examiner's statement directed to a pH modifier, the '610 publication at [0137] and nearby paragraphs do not disclose a pH modifier. The polybasic acid compound (C) [00134] functions as described above to complex with the polyethylenimine. See '610 publication, [0088].

Therefore, for the reasons set forth above with respect to the combined teachings of the '084 patent and the '610 publication, it is submitted that these references in combination fail to render claims 4-6, 12, and 13 obvious under 35 U.S.C. §103, and that the rejection should be withdrawn.

Claims 8-10 stand rejected under 35 U.S.C. §103 as being obvious over the '084 patent in view of Vandersall U.S. Patent Publication 2002/0013403 ('403 publication). Applicants traverse this rejection.

The patentability of the claims over the '084 patent has been discussed above. The '403 publication does not overcome these deficiencies.

The '403 publication discloses colorants to impart color to fire-fighting compositions. The '403 publication discloses yet a third type of fire-fighting composition, i.e., phosphate-containing compositions that are directly applied from planes or vehicles *onto* a fire. The '403 publication discloses the use of improved colorants to make these compositions visible from a distance and that comply with certain environmental regulations (paragraph [0022]). The '403 publication, however, is silent with respect to fire-protecting gels, as presently claimed and does not add anything to the '084 patent in this respect. It should also be noted that the '403 publication explicitly teaches away from using pigments such as titanium dioxide (paragraph [0023]) because the color of such pigments does not fade. Because pigments (i.e., highly insoluble solids) are central to the '084 patent disclosure, wherein titanium dioxide works best, the teachings of the '084 patent and the '403 publication are conflicting.

In short, claims 8-10 recite a preferred embodiment of the present invention. Applicants do not rely solely upon the features recited in claims 8-10 for patentability, but upon *all* the claimed features recited in claims 1 and 8-10. The '403 publication fails to overcome the deficiencies of the '084 patent, as set forth above with respect to claim 1.

It is submitted therefore that a combination of the '084 patent and the '403 publication fails to render claims 8-10 obvious under 35 U.S.C. §103, and that the rejection should be withdrawn.

All claims are in a form and scope for allowance. An early and favorable action on the merits is respectfully requested.

Should the examiner wish to discuss the foregoing, or any matter of form in an effort to advance this application toward allowance, the examiner is urged to telephone the undersigned at the indicated number.

Dated: July 2, 2009

Respectfully submitted,

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Exhibit A

CRC

Handbook

OF

Chemistry and Physics

A Ready-Reference Book of Chemical and Physical Data

HANDBOOK OF CHEMISTRY AND PHYSICS * THE CHEMICAL RUBBER COMPANY *

1970-1971

51st

EDITION

EDITOR

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No.	Name	Synonyms and Formulae	Mol. wt.	Crystalline form, properties and index of refraction	Density or spec. gravity	Melting point, °C	Boiling point, °C	Solubility, in grams per 100 cc: Cold water	Hot water	Other solvents
	Aluminum									
a44	nitrate	$Al(NO_3)_3.9H_2O$	375.13	col, rhomb, deliq, 1.54		73.5	d 150	63.7^{25}	v s d	100 al; s alk, acet, HNO_3, a
a45	nitride	AlN	40.99	wh cr, hex	3.26	>2200 (in N_2)	subl 2000	d (NH_3)	d	d a, alk
a46	oleate (com'l)	$Al(C_{18}H_{33}O_2)_3$(?)	871.37	wh powd, existence doubted except as basic salt				d	s	i al; v sl s bz
a47	oxalate	$Al_2(C_2O_4)_3.4H_2O$	390.08	wh powd				i	i	i al; s a
a48	oxide	Al_2O_3	101.96	col, hex, 1.768, 1.760	3.965^{25}	2045	2980	i		v sl s a, alk
a49	oxide	α-Alumina, nat. corundum. Al_2O_3	101.96	col, rhomb cr, 1.765	3.97	2015 ± 15	2980 ± 60	0.000098^{29}	i	v sl s a, alk
a50	oxide	γ-Alumina. Al_2O_3	101.96	wh micr cr, 1.7	3.5–3.9	tr to α		i	i	sl s a, alk
a51	oxide, monohydrate	$Al_2O_3.H_2O$	119.98	col, rhomb, 1.624 ± 0.003	3.014			i	i	
a52	oxide, trihydrate	Nat. gibbsite, hydrargilite. $Al_2O_3.3H_2O$	156.01	wh monocl cr, 1.577, 1.577, 1.595	2.42	tr to $Al_2O_3.H_2O$ (Boehmite)		i	i	s h a, alk
a53	oxide, trihydrate	Nat. bayerite. $Al_2O_3.3H_2O$	156.01	wh micr cr, 1.583	2.53	tr to $Al_2O_3H_2O$ (Boehmite)		i	i	s hot a, alk
a54	*meta*phosphate	$Al(PO_3)_3$	263.90	col, tetr	2.779			i	i	i a
a55	palmitate, mono- (com'l)	$Al(OH)_2C_{16}H_{31}O_2$	316.41	wh	1.095	200		i		s alk, hydrocarb
a56	1-phenol-4-sulfonate	$Al(C_6H_5O_4S)_3$	546.49	redsh-wh powd				s		s al, glyc
a57	phenoxide	$Al(C_6H_5O)_3$	306.27	grayish-wh cr mass	1.23	d 265		d		s al, eth, chl
a58	*ortho*phosphate	$AlPO_4$	121.95	wh rhomb pl, 1.546, 1.556, 1.578	2.566	>1500		i	i	s a, alk, al
a59	propoxide	$Al(C_3H_7O)_3$	204.25	wh cr	1.0578^{20}_{4}	106	248^{14}	d	d	s al
a60	salicylate	$Al(C_7H_5O_3)_3$	438.33	redsh-wh powd				i		i al; s alk
a61	selenide	Al_2Se_3	290.84	lt brn powd, unstable in air	3.437^{19}_{4}			d	d	d a
a62	silicate	Nat. sillimanite, andalusite, cyanite. $Al_2O_3.SiO_2$	162.04	wh, rhomb, 1.66	3.247	1545 tr to $Al_2O_3.2SiO_2$	>1545	i	i	d HF; i HCl; s fus alk
a63	silicate	Nat. mullite. $3Al_2O_3.2SiO_2$	426.05	col, rhomb, 1.638, 1.642, 1.653	3.156	1920		i	i	i a, HF
a64	stearate, tri-	$Al(C_{18}H_{35}O_2)_3$	877.42	wh powd	1.010	103		i		s al, bz, turp, alk
a65	sulphate	$Al_2(SO_4)_3$	342.15	wh powd, 1.47	2.71	d 770		31.3^{0}	98.1^{100}	s dil a; sl s al
a66	sulfate, hydrate	Nat. alunogenite. $Al_2(SO_4)_3.18H_2O$	666.43	col, monocl, 1.474, 1.467, 1.483	1.69^{17}	d 86.5		86.9^{0}	1104^{100}	i al
a67	sulfide	Al_2S_3	150.16	yel, hex, odor H_2S, d moist air	2.02^{13}	1100	subl 1500 (N_2)	d		s a; i acet
a68	thallium sulfate	Aluminum thallium alum. $AlTl(SO_4)_2.12H_2O$	639.66	col, oct, 1.50112	2.325^{20}_{4}	91		4.84^{0}	65.19^{90}	
a69	**Americium**	Am	243.13	silvery, hex		>850	2600 (extrap)			s dil a
a70	bromide	$AmBr_3$	482.86	wh, orthorhomb		subl		s		
a71	chloride	$AmCl_3$	349.49	pink, hex	5.78	subl 850		s		
a72	fluoride	AmF_3	300.12	pink, hex	9.53			i		
a73	iodide	AmI_3	623.84	yel, orthoromb	6.9			s		
a74	oxide	Am_2O_3	534.26	redsh-brn, cub or tan, or hex						s min a
a75	oxide, di-	AmO_2	275.13	blk, cub	11.68					s min a
a76	**Ammonia**	NH_3	17.03	col gas; liq, 0.817^{-79}, $1.325^{16.5}$	0.7710 g/ml; 760 mm	−77.7	−33.35	89.9	7.4^{100}	13.20^{20} al; s eth, org solv
a77	Ammonia-d_3	Trideuterio ammonia. ND_3	20.06			−74	−30.9			
	Ammonium									
v78	acetate	$NH_4C_2H_3O_2$	77.08	wh cr, hygr	1.17^{20}_{4}	114	d	148^{4}	d	7.89^{15} MeOH; s al; sl s acet
a79	acetate, hydrogen	$(NH_4)H(C_2H_3O_2)_2$	137.14	col need, deliq		66		s		s al
a80	aluminum chloride	$NH_4Cl.AlCl_3$	186.83	wh cr		304		s		
a81	aluminum sulfate	$NH_4Al(SO_4)_2$	237.14	col, hex	2.45^{20}			s		s glyc; i al

No.	Nam
	Ammoniu
a82	aluminum s hydrate
a83	*ortho*arsena
a84	*ortho*arsena
a85	*ortho*arsena mono-H
a86	*meta*arsenit
a87	azide
a88	benzene sul
a89	benzoate
a90	*penta*borate
a91	*peroxy*borat
a92	*tetra*borate
a93	bromate
a94	bromide
a95	*di*bromoiodi
a96	bromoplatin
a97	bromoselena
a98	bromostann
a99	cadmium ch
a100	calcium arse
a101	calcium pho
a102	carbamate
a103	carbamate a carbonate
a104	carbonate
a105	carbonate, h
a106	cerium nitra
a107	cerium nitra
a108	cerium sulfat
a109	chlorate
a110	*per*chlorate
a111	chloride
a112	chloroaurate
a113	chloroaurate,
a114	chlorogallate
a115	chloroiridate
a116	chloroiridite
a117	chloroosmate
a118	chloropallada
a119	chloropalladit
a120	*hexa*chloropla
a121	chloroplatinit
a122	chloroplumba
a123	chlorostannat
a124	*tetra*chlorozin
a125	chromate
a126	*di*chromate
a127	*peroxy*chroma
a129	chromium sul
a130	citrate, di(*sec.*
a131	citrate, tri-(*ter*
a132	cobalt *ortho*phosphate(ous)

ams per 100 cc

Other solvents

s al, alk, alk carb
s al; i bz
sl s al
i liq NH_3
s a, NH_4Cl
s HCl
d Cl_2, F_2, Br_2
abs al 0.017^{14}; i eth
sl s al; i eth
sl s al
s HNO_3; i HCl
i al; s acet
v s al, MeOH
v s MeOH, s al
i al; s conc HCl, conc HNO_3
d a
s a, NH_4Cl; i al
s a, NH_4Cl; i al
s a, NH_4Cl; i al
sl s al, acet, HCl
v s al
al 124^{41}
sl s HCl, HNO_3; v sl s al
v sl s al
sl s HCl, HNO_3, v sl s al
i al; s conc HCl, HNO_3
d a, al; i MeOH, eth
s al
s min a
s h conc H_2SO_4
s conc CrO_3 soln
s a, fus carb
sl s al; s HCl
18^{14} 70 % al
i al
sl s al
sl s al
i al
s HF
s a, NH_4Cl
i al; s conc HCl, conc NHO_3

No.	Name	Synonyms and Formulae	Mol. wt.	Crystalline form, properties and index of refraction	Density or spec. gravity	Melting point, °C	Boiling point, °C	Solubility, in grams per 100 cc: Cold water	Hot water	Other solvents
	Barium									
b45	fluosilicate	$BaSiF_6$	279.42	rhomb need	4.29^{21}_{4}	d 300		0.026^{17}	0.09^{100}	i al; sl s a, NH_4Cl
b46	formate	$Ba(CHO_2)_2$	227.38	col, rhomb, 1.573, 1.597, 1.636	3.21	d		27.76^{0}	39.71^{20}	i al, eth
b47	gluconate	$Ba(C_6H_{11}O_7)_2.3H_2O$	581.69	pr or rhomb leaf		$-3H_2O$, 100; d 120		$3.3^{14.5}$		i al
b48	hydride	BaH_2	139.36	gray cr	4.21^{0}	d 675	1400(?)	d to $Ba(OH)_2$ $+H_2$		d a
b49	hydroxide	$Ba(OH)_2.8H_2O$	315.48	col, monocl, 1.471, 1.502, 1.50	2.18^{16}	78	$-8H_2O$, 780	5.6^{15}	94.7^{78}	sl s al; i acet
b50	hyponitrite	$BaN_2O_2.4H_2O$	269.41	wh cr powd	2.742^{20}					
b51	iodate	$Ba(IO_3)_2$	487.15	monocl	4.998	d		0.008^{0}	197^{100}	s HNO_3, HCl
b52	iodate, hydrate	$Ba(IO_3)_2.H_2O$	505.17	col, monocl	4.657^{15}	$-H_2O$, 200		v sl s	sl s	s HNO_3, HCl; i al, acet, H_2SO_4
b53	iodide	BaI_2	391.15	col cr	5.15^{25}_{4}	740		170^{0}		al 77^{20}
b54	iodide, hydrate	$BaI_2.2H_2O$	427.18	col rhomb, deliq	5.15	$-H_2O$, 98.9; $-2H_2O$, 539; d 740	200^{15}	269^{100}		1.07^{15} al; s acet
b55	iodide, hydrate	$BaI_2.6H_2O$	499.24	col, hex		25.7		410^{0}	v s	v s al
b56	laurate	$Ba(C_{12}H_{23}O_2)_2$	535.97	wh leaf cr		260		$0.008^{14.5}$	0.011^{50}	0.008^{25} al; 0.006^{25} eth
b57	*l*-malate	$BaC_4H_4O_5$	269.41					0.883^{20}	1.044^{80}	
b58	malonate	$BaC_3H_2O_4.H_2O$	257.40	col				0.143^{0}	0.326^{80}	
b59	manganate	$BaMnO_4$	256.28	gray-grn, hex	4.85			v sl s		s a
b60	per-manganate	$Ba(MnO_4)_2$	375.21	br-vlt cr	3.77	d 200		62.5^{11}	75.4^{25}	d al
b61	methylsulfate	$Ba(CH_3SO_4)_2.2H_2O$	395.56	col effl cr				s		s al
b62	molybdate	$BaMoO_4$	297.28	wh powd	4.65	1480		0.0058^{20}		sl s a
b63	myristate	$Ba(C_{14}H_{27}O_2)_2$	592.08					0.007^{25}	0.010^{50}	0.009^{25} al; 0.003^{25} eth 0.046^{15} MeOH
b64	nitrate	Nitrobarite. $Ba(NO_3)_2$	261.35	col cub, 1.572	3.24^{20}	592	d	8.7^{20}	34.2^{100}	i al; sl s a
b65	nitride	Ba_3N_2	440.03	yel-br	4.783^{25}_{4}		1000 vac	d	d	
b66	nitrite	$Ba(NO_2)_2$	229.35	col, hex	3.23^{20}	d 217		67.5^{20}	300^{100}	sl s al
b67	nitrite, hydrate	$Ba(NO_2)_2.H_2O$	247.37	col-yelsh, hex	3.173^{30}	d 115		63^{20}	109.6^{80}	1.6 al; v s HCl; i acet
b68	oxalate	BaC_2O_4	225.36	cr	2.658	d 400		0.0093^{18}	0.0228^{100}	i al; s NH_4Cl, a
b69	oxide	BaO	153.34	col, cub, wh-yelsh powd, 1.98	5.72	1923	ca 2000	3.48^{20}	90.8^{80}	s dil a, al; i acet, NH_3
b70	oxide, per-	BaO_2	169.34	wh-gray powd	4.96	450	$-O$, 800	v sl s	d	s dil a; i acet
b71	oxide, per-, hydrate	$BaO_2.8H_2O$	313.46	col, hex	2.292	$-8H_2O$, 100		0.168	d	s dil a; i al, eth, acet
b72	palmitate	$Ba(C_{16}H_{31}O_2)_2$	648.19	wh cr powd		d		0.004^{15}	0.007^{50}	$0.008^{15.5}$ al; 0.001^{15} eth
b73	*hypo*phosphate	$BaPO_3$	216.31	need				sl s		s al; v sl s ac a
b74	*ortho*phosphate di-	$BaHPO_4$	233.32	wh, rhomb, 1.635, 1.617	4.165^{15}	d 410^{760}		0.01–0.02		s a, NH_4Cl
b75	*ortho*phosphate, mono-	$Ba(H_2PO_4)_2$	331.31	tricl	2.9^{4}			d	d	s a
b76	*ortho*phosphate, tri-	$Ba_3(PO_4)_2$	601.96	wh, cub	4.1^{16}			i	i	s a
b77	*pyro*phosphate	$Ba_2P_2O_7$	448.62	wh, rhomb	3.9^{20}			0.01	sl s	s a, NH_4 salts
b78	*hypo*phosphite	$Ba(H_2PO_2)_2.H_2O$	285.33	wh, monocl	2.90^{17}_{4}	d 100 – 150		30^{15}	33^{100}	i al
b79	propionate	$Ba(C_3H_5O_2)_2.H_2O$	301.50	rhomb, β 1.518		d 300		48^{0}	67.9^{80}	0.08 al
b80	salycylate	$Ba(C_7H_5O_3)_2.H_2O$	437.65	wh need				s		
b81	selenate	$BaSeO_4$	280.30	wh, rhomb	4.75	d		0.0118	0.138^{100}	s HCl; i HNO_3
b82	selenide	$BaSe$	216.30	wh cub disc, n_D, 2.268	5.02			d	d	d HCl
b83	*meta*silicate	$BaSiO_3$	213.42	col, rhomb, 1.673, 1.674, 1.678	4.399	1604		i	d	s HCl
b84	*meta*silicate, hydrate	$BaSiO_3.6H_2O$	351.52	rhomb, 1.542, 1.548, 1.548	2.59			0.17	d	
b85	stearate	$Ba(C_{18}H_{35}O_2)_2$	704.13	wh powd				0.004^{15}	0.006^{50}	$0.005^{15.5}$ al, 0.008^{50} al, 0.001^{15} eth
b86	succinate	$BaC_4H_4O_4$	253.37	wh powd				0.421^{0}	0.237^{80}	sl s al
b87	sulfate	Nat. barite, prec. blanc fixe. $BaSO_4$	233.40	wh, rhomb (monocl), 1.637, 1.638, 1.649	4.50^{15}	1580	tr 1149 monocl	0.000222^{18} 0.000246^{25}	0.000336^{50} 0.000413^{100}	0.006 s 3 % HCl; sl s H_2SO_4
b88	*peroxydi*sulfate	$BaS_2O_8.4H_2O$	401.52	wh, monocl		d		52.2^{0}	d	d al
b89	sulfide, hydro-	$Ba(HS)_2.4H_2O$	275.56	yel, rhomb		d 50		s		i al
b90	sulfide, mono-	BaS	169.40	col, cub, n_D 2.155	4.25^{15}	1200		d	d	i al
b91	sulfide, tetra-	$BaS_4.H_2O$	283.61	red or yel, rhomb	2.988	d 300		41^{15}	v s	i al, CS_2
b92	sulfide, tri-	BaS_3	233.53	yel-grn cr		d 554		s	s	

grams per 100 cc
Other solvents
s a, NH_3
i al, eth; s HCl
s d HCl, s exp conc HNO_3; i al
s al, eth, glycerol
s, NH_4OH
d s
i al, acet, NH_3
i al
i al
s a; v al s NH_4OH
al; s a, NH_4OH
s a, NH_4OH
a; d HNO_3
NH_4OH
.037 conc NH_4OH
a, liq NH_3; sl s al; i bz
s al
s al
HCl; i HNO_3, H_2SO_4
a
a
; s h HNO_3
11^{16} al; i eth
NH_4 salts; s ac a
NO_3; sl s conc SO_4
, acet, a; sl s
H_3, MeOH
acet, a

No.	Name	Synonyms and Formulae	Mol. wt.	Crystalline form, properties and index of refraction	Density or spec. gravity	Melting point, °C	Boiling point, °C	Solubility, in grams per 100 cc: Cold water	Hot water	Other solvents
	Calcium									
c87	butyrate	$Ca(C_4H_7O_2)_2 \cdot 3H_2O$	268.32	col cr				s	sl s	
c88	carbide	CaC_2	64.10	col, tetr, 1.75	2.22	trans 25, 447	2300	d	d	
c89	carbonate	Nat. aragonite, $CaCO_3$	100.09	col, rhomb, 1.530, 1.681, 1.685	2.930	tr. to calcite 520	d 825	0.00153^{25}	0.00190^{75}	s a, NH_4Cl
c90	carbonate	Nat. calcite, $CaCO_3$	100.09	col, rhomb or hex, 1.6583, 1.4864	2.710	$1339^{102.5}$	d 898.6	0.0014^{25}	0.0018^{75}	s a, NH_4Cl
c91	carbonate, hexahydrate	$CaCO_3 \cdot 6H_2O$	208.18	col, monocl, 1.460, 1.535, 1.545	1.771					
c92	chlorate	$Ca(ClO_3)_2$	206.99	wh cr, hyg		340 ± 10 some O_2		s	s	s al, acet
c93	chlorate, dihydrate	$Ca(ClO_3)_2 \cdot 2H_2O$	243.01	wh-yelsh, rhomb or monocl, deliq	2.711	$-H_2O$, 100		177.7	v s	s al, acet
c94	*per*chlorate	$Ca(ClO_4)_2$	238.98	col cr	2.651	d 270		188.6	v s	166.2^{25}_{25} al; 237.4 MeOH
c95	chloride	$CaCl_2$	110.99	col, cub, deliq, 1.52	2.15^{25}	772	>1600	74.5	159	s al, acet, ac a
c96	chloride aluminate	$3CaO \cdot Al_2O_3 \cdot CaCl_2 \cdot 10H_2O$	561.33	col, monocl or hex, hex 1.550, 1.535	1.892	$-4H_2O$, 105	$-8H_2O$, 350	sl s	d	s a
c97	chloride, dihydrate	$CaCl_2 \cdot 2H_2O$	147.02	col cr	0.835			97.7	326.8	50 al
c98	chloride, hexahydrate	$CaCl_2 \cdot 6H_2O$	219.08	col, trig, deliq, 1.417, 1.393	1.71	29.92	$-4H_2O$, 30; $-6H_2O$, 200	279	536	s al
c99	chloride, monohydrate	$CaCl_2 \cdot H_2O$	129.00	col cr, deliq		260		76.8	249	s al; s acet
c100	chloride fluoride *ortho*phosphate	$3Ca_3(PO_4)_2 \cdot Ca(Cl,F)_2$	1025.08	col cr, 1.651, 1.654	3.14	1270		v sl s		
c101	chlorite	$Ca(ClO_2)_2$	174.98	wh cub	2.71			d	d	i al
c102	*hypo*chlorite	$Ca(ClO)_2$	142.98	wh powd or flat pl 1.545, 1.69	2.35	d 100		s		i al
c103	chlorite, basic	$Ca(ClO)_2 \cdot 2Ca(OH)_2$	[illegible]	wh, hex, 1.5, 1.585	2.10			sl s solns with 5-6 % avail Cl	d	d a
c104	*hypo*chlorite, basic	Bleaching powder, chlorinated lime, $Ca(ClO)_2 \cdot CaCl_2 \cdot Ca(OH)_2 \cdot 2H_2O$	comp varies	wh powd strong Cl odor		d		d evln Cl_2		d a
c105	*hypo*chlorite, trihydrate	$Ca(ClO)_2 \cdot 3H_2O$	197.03	tetr pl 1.535, 1.63	2.3	$-3H_2O$, 60				
c106	chromate	$CaCrO_4 \cdot 2H_2O$	192.09	yel, monocl pr		$-2H_2O$, 200		16.3^{20}	18.2	s a, al
c107	chromite	$CaCr_2O_4$	208.07	ol grn, cub need	4.8	2090		i	i	i a, s fus K_2CO_3
c108	cinnamate	$Ca(C_9H_7O_2)_2 \cdot 3H_2O$	388.41	col cr				0.22	1.3	
c109	citrate	$Ca_3(C_6H_5O_7)_2 \cdot 4H_2O$	570.51	wh need		$-4H_2O$, 120		0.85	0.96	0.0065 al
c110	cyanamide	$CaCN_2$	80.10	col, hex, rhomb		1300 subl >1150		d evl NH_3	d	
c111	cyanide	$Ca(CN)_2$	92.12	wh powd		d >350		d	d	
c112	cyanoplatinite	$CaPt(CN)_4 \cdot 5H_2O$	429.31	yel grn fluoresc, rhomb, 1.62		$-5H_2O$, 100		s		
c113	ferricyanide	$Ca_3[Fe(CN)_6]_2 \cdot 12H_2O$	760.42	red need, deliq				v s	v s	
c114	ferrite, mono	$CaO \cdot Fe_2O_3$	215.77	dk redsh br rhomb 2.58, 2.43 (Na)	5.08	1250		i	i	v sl s a
c115	ferrocyanide	$Ca_2Fe(CN)_6 \cdot 11$ or $12H_2O$	490.28	yel tricl 1.570, 1.582, 1.596	1.68	d		86.8^{25}	115^{65}	i al
c116	fluosilicate	$CaSiF_6$	182.16	col tetr	2.662			sl s		s al, HF, HCl
c117	fluoride	Nat. fluorite, CaF_2	78.08	col, cub luminesc w heat 1.434	3.180	1360	ca 2500	0.0016^{18}	0.0017^{26}	s NH_4 salts; sl s a; i acet
c118	fluosilicate, dihydrate	$CaSiF_6 \cdot 2H_2O$	218.19	col, tetrag	2.254			sl s d		s HCl, HF; i al
c119	formate	$Ca(CHO_2)_2$	130.12	col, rhomb 1.510, 1.514, 1.578	2.015	d		16.2	18.4^{100}	i al
c120	fumarate	$CaC_4H_2O_4 \cdot 3H_2O$	208.18	col, rhomb				2.11^{30}		
c121	*d*-gluconate	$Ca(C_6H_{11}O_7)_2 \cdot H_2O$	448.40	wh cr powd, need		$-H_2O$, 120		3.3^{15}		v sl s al
c122	glycerophosphate	$CaC_3H_5(OH)_2PO_4$	210.16	wh cr powd, hyg		d 170		2	sl s	i al
c123	hydride	CaH_2	42.10	wh, rhomb cr	1.9	816 in H_2, d ca 600		d H_2 + $Ca(OH)_2$		d a
c124	hydroxide	$Ca(OH)_2$	74.09	col, hex, 1.574, 1.545	2.24	$-H_2O$, 580	d	0.185	0.077^{100}	s NH_4 salts, a; i al
c125	hyponitrite	$CaN_2O_2 \cdot 4H_2O$	172.15	wh cr	1.834	d 320				d dil a
c126	iodate	Nat. lautarite, $Ca(IO_3)_2$	389.89	col, monocl	4.519^{15}	d 540		0.20^{15}	0.67^{90}	s HNO_3; i al
c127	iodate, hexahydrate	$Ca(IO_3)_2 \cdot 6H_2O$	497.98	col, rhomb		d 35		0.13	1.22^{100}	s HNO_3
c128	iodide	CaI_2	293.89	yelsh-wh, hex, deliq	3.956^{25}_{4}	740	ca 1100	209^{20}	426^{100}	126^{20} MeOH; s al, acet, a

No.	Name	Synonyms and Formulae	Mol. wt.	Crystalline form, properties and index of refraction	Density or spec. gravity	Melting point, °C	Boiling point, °C	Solubility, in grams per 100 cc		
								Cold water	Hot water	Other solvents
	Chlorine									
c369	**Chlorine**	Cl_2	70.906	grnsh-yel gas, or liq, or rhomb cr; gas 1.000768, liq 1.367	3.214^{0}	−100.98	−34.6	310^{10} cm³ 1.46^{0} g	177^{30} cm³, 0.57^{30} g	s alk
c370	azide	chlor(o)azide ClN_3	77.48	gas, expl				sl s		d alk
c371	fluoride, mono-	ClF	54.45	col gas	1.62^{-100}	−154 ± 5	−100.8	d	d	
c372	fluoride, tri-	ClF_3	92.45	col gas	1.77^{13}	−83	11.3	d	d	
c373	hydrate	$Cl_2.8H_2O$	215.03	lt yel, rhomb	1.23	d 9.6		i		s alk
c374	oxide, di-	ClO_2	67.45	yel red gas, or red cr, expl	3.09^{11} g/l	−59.5	9.9^{731} exp	2000^{4} cm³	d to $HClO_3$, Cl_2, O_2	s alk, H_2SO_4
c375	oxide, hept-	Cl_2O_7	182.90	col oil		−91.5	82	s d		s bz
c376	oxide, mono-	Cl_2O	86.91	yel-red gas, or red-br liq	3.89^{0} g/l	−20	3.8^{744} exp	200 cm³	d to HOCl	s alk, H_2SO_4
c377	oxide, tetr-	ClO_4 or Cl_2O_8	99.45				d	s d		s bz
c378	chloroauric acid	$HAuCl_4.4H_2O$	411.85	brt yel need, deliq		d		s	v s	s al, eth
c379	chloroplatinic acid	$H_2PtCl_6.6H_2O$	517.92	red br pr, deliq	2.431	60		v s	v s	s al, eth
c380	chlorostannic acid	$H_2SnCl_6.6H_2O$	441.52	col leaf	1.93	9		s		
c381	**Chlorosulfonic acid**	$ClSO_3H$	116.52	col fum liq, 1.437^{14}	1.766^{18}	−80	158	d to H_2SO_4 + HCl		d al, a; i CS_2
c382	**Chlorotetroxy fluoride**	ClO_4F	118.45	col gas, v exp		−167.3	−15.9			
c383	**Chloryl (per-)fluoride**	ClO_3F	102.45	gas	1.392^{20}	−146	−46.8			
c384	**Chromium**	Cr	51.996	steel gray, cub v hard	7.20^{28}	1890	2482	i	i	s dil H_2SO_4, HCl; i HNO_3, aq reg
c385	(II) acetate	$Cr(C_2H_3O_2)_2$	170.09	red cr				sl s	s	sl s al
c386	(III) acetate	$Cr(C_2H_3O_2)_3.H_2O$	247.15	gray-grn powd or blsh-grn pasty mass				s		i al
c387	arsenide, mon-	CrAs	126.92	gray, hex	6.35^{14}			i	i	i a
c388	boride, mono-	CrB	62.81	silv cr, orthorhomb	6.17	2760(?)		i	i	s fus Na_2O_2
c389	(II) bromide	$CrBr_2$	211.81	wh cr	4.356	842		s	s	s al
c390	(III) bromide	$CrBr_3$	291.72	olv gr, hex	4.250^{25}_{4}	subl		i	s	v s al; d alk
c391	bromide, hexahydrate	$[CrBr_2(H_2O)_4]Br.2H_2O$	399.81	grn cr, deliq				s	s tr to vlt	s al; i eth
c392	bromide, hexahydrate	$[Cr(H_2O)_6]Br_3$	399.81	blsh gray to vlt	5.4^{17}			v s	v s	i al
c393	(tri-)carbide, di-	Cr_3C_2	180.02	gray, rhomb	6.68	1890	3800	i	i	
c394	carbonyl	$Cr(CO)_6$	220.06	col, orthorhomb	1.77	d 110	210 exp	i	i	i al, eth, ac a; sl s CHI_3, CCl_4
c395	(II) chloride	$CrCl_2$	122.90	wh need, deliq	2.878^{25}	824		v s	v s	i al, eth
c396	(III) chloride	$CrCl_3$	158.35	vlt, trig	2.76^{15}	ca 1150	subl 1300	i	sl s	i al, acet, MeOH, eth
c397	chloride, hexahydrate	$[Cr(H_2O)_4Cl_2].2H_2O$	266.45	vlt, monocl	1.76	83		58.5^{25}	s	s al; i eth; sl s acet
c398	(II) fluoride	CrF_2	89.99	grn, cr, monocl	4.11	1100	>1300	sl s		i al; s h HCl
c399	(III) fluoride	CrF_3	108.99	grn, rhomb	3.8	>1000	subl 1100–1200	i		i al, NH_3; sl s a; s HF
c400	(II) hydroxide	$Cr(OH)_2$	86.01	yel-br		v		d		s a
c401	iodate, hydrate	$[Cr(H_2O)_6]I_3.3H_2O$	594.85	dk vlt cr, hygro	4.915^{25}_{4}	41 − HI		v s	v s	s al, acet; i CHI
c402	(II) iodide	CrI_2	305.80	graysh powd	5.196	856	subl vac 800	s		
c403	(III) iodide	CrI_3	432.71	shiny blk cr	4.915^{25}_{4}	>600	$-I_2$, vac 350			
c404	(III) nitrate	$Cr(NO_3)_3.7\frac{1}{2}H_2O$	373.13	br, monocl		100	d	s	s	
c405	(III) nitrate	$Cr(NO_3)_3.9H_2O$	400.15	purple, monocl		60	d 100	s	s	s a, alk, al, acet
c406	nitride, mono-	CrN	66.00	cub or amorph	5.9	d 1700		i	i	sl s aq reg
c407	(II) oxalate	$CrC_2O_4.H_2O$	158.03	yel cr powd	2.468			sl s	s	s dil a
c408	(III) oxalate	$Cr_2(C_2O_4)_3.6H_2O$	476.14	red, amorph, hyg		120, $-H_2O$ tr to grn		s	s	v s (red) al, eth; i (grn) al
c409	oxide, di-	CrO_2	84.00	br-blk powd		300, −O		i		s HNO_3
c410	(II) oxide, mon-	CrO	68.00	blk powd				i	i	i dil HNO_3
c411	(III) oxide, sesqui-	Cr_2O_3	151.99	grn, hex, 2.551	5.21	2435	4000	i	i	i a, alk, al
c412	(III) oxide, sesqui-	$Cr_2O_3.xH_2O$	varies	vlt, amorph or bl-gray grn gel				i	i	s a, alk; sl s NH_4OH
c413	oxide, tri-	Chromic anhydride, "chromic acid", CrO_3	99.99	red, rhomb, deliq	2.70	196	d	61.7^{0}	67.45^{100}	s al, eth, H_2SO_4 HNO_3
c414	oxychloride	CrO_2Cl_2	154.90	dk red liq	1.911	−96.5	117	d	d	d al; s eth, ac a
c415	2,4-pentandione	Chromium acetyl-acetonate, $Cr(C_5H_7O_2)_3$	349.33			216	340	i		s org solv; i lgr

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								Cold water	Hot water	Other solvents
	Lead									
142	borofluoride	$Pb(BF_4)_2$	380.80	cr pr				d		d al
143	bromate	$Pb(BrO_3)_2.H_2O$	481.02	col, monocl	5.53	d 180		1.38^{20}	sl s	
144	bromide	$PbBr_2$	367.01	wh, rhomb	6.66	373	916	0.4554^{0} 0.8441^{20}	4.71^{100}	s a, KBr; sl s NH_3; i al
145	butyrate	$Pb(C_4H_7O_2)_2$	381.39	col scales, pois		90		i	i	s dil HNO_3
146	caprate	$Pb(C_{10}H_{19}O_2)_2$	549.71			103–104		i	i	0.0029^{20} eth
147	caproate	$Pb(C_6H_{11}O_2)_2$	437.50			73–74				1.09^{20} eth
148	caprylate	Lead octoate. $Pb(C_8H_{15}O_2)_2$	493.60	wh leaf		83.5–84.5		i	i	s al; 0.0938 eth
149	carbonate	Nat. cerussite. $PbCO_3$	267.20	col, rhomb, 1.804, 2.076, 2.078	6.6	d 315		0.00011^{20}	d	s a, alk; i NH_3, al
150	carbonate, basic	White lead, hydrocerussite. $2PbCO_3.Pb(OH)_2$	775.60	wh powd, or hex.	61.4	d 400		i	i	sl s aq CO_2; s HNO_3; i al
151	cerotate	$Pb(C_{26}H_{51}O_2)_2$	998.57	wh need		113		i		i al, eth; s bz
152	chlorate	$Pb(ClO_3)_2$	374.09	wh monocl, deliq	3.89	d 230		v s		s al
153	chlorate, hydrate	$Pb(ClO_3)_2.H_2O$	392.11	wh, monocl, deliq.	4.037	d 110		151.3^{18}	171^{49}	s al
154	perchlorate	$Pb(ClO_4)_2.3H_2O$	460.14	wh, rhomb	2.6	d 100		499.7^{25}		s al
155	chloride	Nat. cotunite. $PbCl_2$	278.10	wh, rhomb, 2.199, 2.217, 2.260	5.85	501	950^{760}	0.99^{20}	3.34^{100}	sl s dil HCl,NH_3; i al; s NH_4 salts
156	chloride, tetra-	$PbCl_4$	349.00	yel oily liq	3.18^{0}	−15	expl 105	d (Cl_2)	d	s conc HCl
157	chloride, sulfide	$PbCl_2.3PbS$	995.86	red				i	d	d a, alk; i dil a
158	chlorite	$Pb(ClO_2)_2$	342.09	yel, monocl		expl 126		0.095^{20}	0.42^{100}	s KOH
159	chromate	Nat. crocoite, chrome yellow. $PbCrO_4$	323.18	yel, monocl, 2.31, 2.37(Li), 2.66	6.12^{15}	844	d	0.0000058^{25}	i	s a, alk; i ac a, NH_3
160	chromate, basic	Chrome red. $PbCrO_4.PbO$	546.37	red cr powd	6.63			i	i	s a, alk
161	chromate, basic	$Pb_2(OH)_2CrO_4$	564.39	red amorph or cr	6.63	920		i	i	s KOH
162	dichromate	$PbCr_2O_7$	423.18	red cr				d		s a, alk
163	citrate	$Pb_3(C_6H_5O_7)_2.3H_2O$	1053.82	wh cr powd				s		v sl s al
164	cyanate	$Pb(OCN)_2$	291.22	wh need		d		i	sl s	
165	cyanide	$Pb(CN)_2$	259.23	yelsh-wh powd, pois				sl s	s	s KCN
166	enanthate	$Pb(C_7H_{13}O_2)_2$	465.55	wh leaf		91.5		sl s		i al
167	ethylsulfate	$Pb(C_2H_5SO_4)_2.2H_2O$	493.57	col liq, pois				s		
168	ferricyanide	$Pb_3[Fe(CN)_6]_2$.5 (or 6) H_2O	1135.55	blk-brn to red, monocl pr		$-H_2O$, 110–120 d		sl s	s, d 100	s alk, HNO_3
169	ferrite	$PbFe_2O_4$	382.88	hex		1530 d, 725				
170	ferrocyanide	$Pb_2Fe(CN)_6.3H_2O$	680.38	yelsh-wh powd		$-H_2O$, 100		i		sl s H_2SO_4
171	fluoride	PbF_2	245.19	col, rhomb, pois	8.24	855	1290	0.064^{20}		s HNO_3; i acet, NH_3
172	fluorochloride	Nat. matlockite. PbFCl	261.64	wh, tetr, 2.145, 2.006	7.05	601		0.037^{25}	0.1081^{100}	
173	fluosilicate	$PbSiF_6.2H_2O$	385.30	col, monocl		d		s	v s	
174	fluosilicate, tetrahydrate	$PbSiF_6.4H_2O$	421.33	col, monocl		d<100				
175	formate	$Pb(CHO_2)_2$	297.23	wh, rhomb, lust, 1.789, 1.852, 1.877	4.63	d 190		1.6^{16}	20^{100}	i al
176	hydride, di-	PbH_2	209.21	gray powd		d				
177	hydroxide	$Pb(OH)_2$	241.20	wh, amorph		d 145		0.0155^{20}	sl s	s a, alk; i ac a
178	hydroxide	$Pb_2O(OH)_2$ or $2PbO.H_2O$	464.39	wh cub, or amorph powd, pois	7.592	d 145		0.014	sl s	s alk, ac a, HNO_3
179	iodate	$Pb(IO_3)_2$	557.00	wh	6.155^{20}	d 300		0.0012^{2}	0.003^{25}	sl s HNO_3; i NH_3
180	paraperiodate	$PbHIO_5$	415.10	wh cr		d 130		i	i	s dil HNO_3
181	paraperiodate, hydrate	$PbHIO_5.H_2O$	433.11	amorph		$-H_2O$, 110		i	i	sl s dil HNO_3
182	iodide, basic	$PbI_2.PbO.H_2O$	702.20	rhomb cr	6.83^{20}	d 100				
183	iodide,di-	PbI_2	461.00	yel hex powd, pois	6.16	402	954	0.044^{0} 0.063^{20}	0.41^{100}	s alk, KI; i al
184	iodide, mono-	PbI	334.09	pa yel		d 300		0.1		
185	isobutyrate	$Pb(C_4H_7O_2)_2$	381.39	wh pr		<100		9.1^{16}		
186	lactate	$Pb(C_3H_5O_3)_2$	385.33	wh cr powd				s		s h al
187	laurate	$Pb(C_{12}H_{23}O_2)_2$	605.82	chalky wh powd		104.7		0.009^{25}		0.008^{25} al; $0.007^{14.5}$ eth
188	lignocenate	$Pb(C_{24}H_{47}O_2)_2$	942.47	wh powd		117		i		v s h bz; sl s al; i eth
189	malate	$Pb(C_4H_4O_5).3H_2O$	393.31	wh powd				sl s		v sl s al
190	melissate	$Pb(C_{31}H_{61}O_2)_2$	1138.85	wh powd		115–116		i	i	s boil tol, ac a; sl s h bz, chl; i al, eth
191	molybdate	Nat. wulfenite. $PbMoO_4$	367.13	col-lt yel, tetr pl	6.92^{75}_{4}	1060–1070			i	d conc H_2SO_4; s a, KOH; i al
192	myristate	$Pb(C_{14}H_{27}O_2)_2$	661.93	wh powd		107		0.005^{25}	0.006^{50}	0.004^{25} al; $0.010^{14.5}$ eth

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	Tin									
t208	(II) nitrate	$Sn(NO_3)_2 \cdot 20H_2O$	603.07	col leaf		−20		d	d	d HNO_3
t209	(II) nitrate, basic	$SnO \cdot Sn(NO_3)_2$	377.49	wh cr mass		d >100 expl		d	d	
t210	(IV) nitrate	$Sn(NO_3)_4$	366.71	silky need		d 50		d		
t211	(II) oxide, mon-	SnO	134.69	blk, cub (tetr.)	6.446°	d 1080^{600}		i	i	s a, alk; sl s NH_4Cl
t212	oxide, mon-hydrate	$SnO \cdot xH_2O$		wh powd or yellow-brn cr					d to SnO	d a, alk; s alk carb; i NH_4OH
t213	(IV) oxide, di-	Nat. cassiterite, SnO_2	150.69	wh, tetr, (also hex or rhomb), 1.997, 2.093	6.95	1127	subl 1800–1900	i	i	d KOH, NaOH; i aq reg
t214	oxide, di-hydrate	α Stannic acid or "ordinary" stannic acid, $SnO_2 \cdot xH_2O$		amorph or gel				i	i	s a, alk, K_2CO_3
t215	oxide, di-hydrate	β Stannic acid or "meta" stannic acid, $SnO_2 \cdot xH_2O$		wh amorph or gel				i	i	i a, K_2CO_3; sol alk
t216	(II) *meta*phosphate	$Sn(PO_3)_2$	276.63	amorph mass	3.380$^{27.4}$					
t217	(II) *ortho*phosphate	$Sn_3(PO_4)_2$	546.01	wh, amorph	3.823^{0}			i	i	d a, alk
t218	(II) *ortho*phosphate, di-H	$Sn(H_2PO_4)_2$	312.66	wh, rhomb cr	3.167$^{27.5}$	d	d		d	
t219	(II) *ortho*phosphate, mono-H	$SnHPO_4$	214.67	cr	3.476$^{25.5}$	stabl >100	d	i	i	s dil min a
t220	(II) *pyro*phosphate	$Sn_2P_2O_7$	411.32	amorph powd	4.009^{16}					s conc a
t221	phosphide, mono-	SnP	149.66	silv wh	6.56	d	d	i	i	s HCl, i HNO_3
t222	phosphide, tri-	SnP_3	211.61	cr	4.10°	>415 d to Sn_4P_3		i	i	d HNO_3, i HCl
t223	*tetra*phosphide, tri-	Sn_4P_3	567.68	wh cr	5.181	d >480		i	i	d fixed alk hydr, HCl
t224	phosphorus chloride	$SnCl_4 \cdot PCl_5$	468.74	col cr		subl 200		d	d	
t225	(II) selenide	SnSe	197.65	steelgray cr	6.179°	861		i	i	d HCl, HNO_3, aq reg, alk sulf
t226	(II) sulfate	$SnSO_4$	214.75	wh yelsh cr powd		>360 (SO_2)		33^{25}		s H_2SO_4
t227	(IV) sulfate	$Sn(SO_4)_2 \cdot 2H_2O$	346.84	wh, hex pr, deliq				v s	d	s eth, dil H_2SO_4, HCl
t228	(II) sulfide	SnS	150.75	gray-blk cub, monocl	5.22^{25}	882	1230	0.000002^{18}		d HCl, alk, $(NH_4)_2S$
t229	(IV) sulfide	Mosaic gold, SnS_2	182.82	gold yel, hex	4.5	d 600		0.0002^{18}		d alk sulf, aq reg, alk hydr, PCl_3, $SnCl_2$; i a
t230	(IV) sulfur chloride	$SnCl_4 \cdot 2SCl_4$	608.25	yel cr		37	d >40	d	d	s eth, bz, CS_2, ethyl acet; d HNO_3
t231	tartrate	$SnC_4H_4O_6$	266.76	heavy wh powd				s		v s dil HCl
t232	(II) telluride	SnTe	246.29	gray cr	6.48	780	d	i	i	d alk sulf
t233	(IV) telluride	$SnTe_2$	373.89	blk, floc ppt				i	i	d dil a, alk
t234	**Titanic acid, ortho-**	α Titanic acid, H_4TiO_4	113.91	wh		d		v sl s d		s dil HCl, dil H_2SO_4, conc alk
t235	**Titanium**	Ti	47.90	α hex, tr β cub 858, silv gray	4.5^{20}	1675	3260	i	i	s dil a
t236	boride, di-	TiB_2	69.52	hex	4.50	2900				
t237	bromide, di-	$TiBr_2$	207.72	blk powd	4.31	d >500		s ev H_2		
t238	bromide, tetra-	$TiBr_4$	367.54	or yel, deliq	2.6	39	230	d		s abs al, abs eth
t239	bromide, tri-	$TiBr_3 \cdot 6H_2O$	395.72	redsh-viol or dk blue cr, deliq		115	d 400	v s		v s al, acet
t240	carbide	TiC	59.91	gr met, cub	4.93	3140±90	4820	i	i	s aq reg, HNO_3
t241	chloride, di-	$TiCl_2$	118.81	lt br blk, hex, deliq	3.13	subl H_2	d 475 vac	d		s al, i eth, chl, CS_2
t242	chloride, tetra-	$TiCl_4$	189.71	lt yel liq, 1.61$^{10.5}$	liq 1.726; sol 2.06^{-79}	−25	136.4	s	d	s dil HCl, al
t243	chloride, tri-	$TiCl_3$	154.26	dk viol, deliq	2.64	d 440	660^{106}	s	s	v s al; s HCl; i eth
t244	fluoride, tetra-	TiF_4	123.89	wh powd, hygr	2.798$^{20.5}$	>400 (pressure)	284 (subl.)	s d		s H_2SO_4, al, C_5H_5N; i eth
t245	fluoride, tri-	TiF_3	104.90	purp-red or vlt	3.40	1200	1400	red s vlt i		
t246	hydride	TiH_2	49.92	gray powd	3.9^{12}	d 400				
t247	iodide, di-	TiI_2	301.71	blk, hygr	4.99	600	1000	d		d alk; s conc HF, conc HCl
t248	iodide, tetra-	TiI_4	555.52	red, cub	4.3	150	377.1	v s	d	
t249	nitride	TiN	61.91	yel-bronze, cub	5.22	2930		i	i	sl s hot aq reg + HF
t250	oxalate	$Ti_2(C_2O_4)_3 \cdot 10H_2O$	540.01	yel pr				s	s	i al, eth
t251	oxide, di-	Nat. brookite, TiO_2	79.90	wh, rhomb, 2.583, 2.586, 2.741	4.17	1825		i	i	s H_2SO_4, alk; i a
t252	oxide, di-	Nat. octahedrite, anatase, TiO_2	79.90	br-blk, tetr, 2.554, 2.493	3.84			i	i	s H_2SO_4, alk; i a

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	Zinc									
z59	*ortho*phosphate, tetrahydrate	α—Hopeite. $Zn_3(PO_4)_2.4H_2O$	458.11	col, rhomb, 1.572, 1.591, 1.59	3.04	tr >105		i	i	v s a, NH_4OH, NH_4 salts
z60	*ortho*phosphate tetrahydrate	β-Hopeite. $Zn_3(PO_4)_2.4H_2O$	458.11	col, rhomb, 1.574, 1.582, 1.582	3.03	tr >140		i	i	v s a, NH_4OH, NH_4 salts
z61	*ortho*phosphate tetrahydrate	Parahopeite. $Zn_3(PO_4)_2.4H_2O$	458.11	col, tricl, 1.614, 1.625, 1.665	3.75	tr >163		i	i	v s a, NH_4OH, NH_4 salts
z62	*pyro*phosphate	$Zn_2P_2O_7$	304.68	wh powd	3.75^{15}			i	i	s a, alk, NH_4OH
z63	phosphide	Zn_3P_2	258.06	dk gray, tetrag, pois	4.55^{13}	>420	1100; subl in H_2	d		d H_2SO_4 ev H_3P s HNO_3; s (viol) dil a; i al
z64	hypophosphite	$Zn(H_2PO_2)_2.H_2O$	213.36	col, cr powd, hygr				s		s alk
z65	picrate	$Zn(C_6H_2N_3O_7)_2.8H_2O$	665.69	yel cr powd, expl		expl		s		
z66	salicylate	$Zn(C_7H_5O_3)_2.3H_2O$	393.65	need				5^{20}		s al
z67	selenate	$ZnSeO_4.5H_2O$	298.40	wh, tricl	2.591^{20}_{4}	d >50		s		
z68	selenide	ZnSe	144.33	yelsh to redsh, cub, 2.89	5.42^{15}_{4}	>1100		i		s a, d HNO_3
z69	silicate	Nat. hemimorphite. $2ZnO.SiO_2.H_2O$	240.84	rhomb, or trigon 1.614, 1.617, 1.636	3.45			i	i	
z70	*meta*silicate	$ZnSiO_3$	141.45	col, rhomb	3.42	1437		i		i a
z71	*ortho*silicate	Nat. willemite. Zn_2SiO_4	222.82	trig, 1.694, 1.723	4.103	1509		i	i	s acet a
z72	stearate	$Zn(C_{18}H_{35}O_2)_2$	632.33	light powd		130		i		i al, eth
z73	sulfate	Nat. zinkosite. $ZnSO_4$	161.43	col, rhomb, 1.658, 1.669, 1.670	3.54^{25}_{4}	d 600		s	s	sl s al, s MeOH, glyc
z74	sulfate, heptahydrate	Nat. goslarite. $ZnSO_4.7H_2O$	287.54	col, rhomb, effl, 1.457, 1.480, 1.484	1.957^{25}_{4}	100	$-7H_2O$, 280	96.5^{20}	663.6^{100}	sl s al, glyc
z75	sulfate, hexahydrate	$ZnSO_4.6H_2O$	269.52	col, monocl or tetrag	2.072^{15}	$-5H_2O$, 70		s	117.5^{80}	
z76	sulfide,(α)	Nat. wurtzite. ZnS	97.43	col, hex, 2.356, 2.378	3.98	$1850^{150 atm}$	subl 1185	0.00069^{18}		v s a; i ac a
z77	sulfide,(β)	Nat. sphalerite. ZnS	97.43	col, cub, 2.368	4.102^{25}	tr 1020		0.000065^{18}		v s a
z78	sulfide, monohydrate	$ZnS.H_2O$	115.45	yelsh-wh powd	3.98	1049		i		s a
z79	sulfite	$ZnSO_3.2H_2O$	181.46	wh, cr powd		$-2H_2O$, 100	d 200	0.16	d	i al; s H_2SO_3
z80	tartrate	$ZnC_4H_4O_6.H_2O$ (or $2H_2O$)	231.46	wh powd				0.055^{20}		s KOH, NaOH
z81	tellurate	Zn_3TeO_6	419.71	wh, gran ppt				i	i	s a
z82	telluride	ZnTe	192.97	red, cub, 3.56	6.34^{15}	1238.5		d		s d a
z83	thiocyanate	$Zn(SCN)_2$	181.53	wh powd, deliq				s		s al, NH_4OH
z84	valerate	$Zn(C_5H_9O_2)_2.2H_2O$	303.65	wh glist sc or powd				2.6^{16}	s	ca 2.5 al; v sl s eth
	Zinc complexes									
z85	diamminezinc chloride	$[Zn(NH_3)_2]Cl_2$	170.34	col, rhomb, 1.625, 1.590	2.10	210.8	d 271	d		
z86	tetrammine perrhenate	$[Zn(NH_3)_4](ReO_4)_2$	633.89	wh, cub cr	3.608^{23}_{4}					0.1852 conc NH_4OH
z87	tetrapyridine fluosilicate	$[Zn(C_5H_5N)_4]SiF_6$	523.86	wh, rhomb	2.197					
z88	**Zirconium**	Zr	91.22	silver gray, met	6.49	1852 ± 2	3578	i	i	s HF, aq reg; sl s a
z89	bromide, di-	$ZrBr_2$	251.04	blk powd, ign in air		d >350		d ev H_2		
z90	boride, di-	ZrB_2	112.84	hex	6.085	ca 3000				
z93	bromide, tetra-	$ZrBr_4$	410.86	wh cr powd, deliq		$450 \pm 1^{15 atm}$	357 subl	i d		s liq NH_3, acetone; i bz, CCl_4
z94	bromide, tri-	$ZrBr_3$	330.95	bl-blk powd		d 350		d ev H_2		
z95	carbide	ZrC	103.23	gray met, cub	6.73	3540	5100	i		sl s conc H_2SO_4
z96	carbonate, basic	$3ZrO_2.CO_2.H_2O$	431.68	wh, amorph powd				i		s a
z97	chloride, di-	$ZrCl_2$	162.13	blk	3.6^{16}	d 350		d ev H_2		
z98	chloride, tetra-	$ZrCl_4$	233.03	wh cr	2.803^{15}	$437^{25 atm}$	subl 331	s	d	s al, eth, conc HCl
z99	chloride, tri-	$ZrCl_3$	197.58	br cr	3.00^{16}	d 350		d ev H_2		s $-H_2$ conc al; i org cpd
z100	fluoride	ZrF_4	167.21	wh hex, 1.59	4.43	subl ~ 600		1.388^{25}	d	sl s HF
z101	hydride	ZrH_2	93.24	gray-blk powd						s dil HF, conc a
z102	hydroxide	$Zr(OH)_4$	159.25	wh amorp powd	3.25	$-2H_2O$, 500		0.02	i	s min a
z103	iodide	ZrI_4	598.84	wh need, hygr		499 ± 2 6.3^{atm}	d ~600	s d	s	d al; s eth; v sl s CS_2, bz; i liq NH_3
z104	nitrate	$Zr(NO_3)_4.5H_2O$	429.32	col cr, deliq, 1.60, 1.61				v s		s al

THE
MERCK INDEX

AN ENCYCLOPEDIA OF
CHEMICALS AND DRUGS

NINTH EDITION

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pure, usually contg an excess of CaO. Occurs in nature as the minerals: *oxydapatit, voelicherite, whitlockite.* The technical product is also known as "*bone ash*". Commercial prepn from phosphate rock: Hignett, Hubbard, *Ind. Eng. Chem.* **38,** 1208 (1946); Elmore, **U.S.** pat. **2,474,831** (1949 to T.V.A.); Hollingsworth, **U.S.** pats. **2,556,541** and **2,562,718** (both 1951 to Coronet Phosphate); Brosheer, Hignett, *Chem. Eng. Rept.* no. 7, 143 pp (1953).

Amorphous, odorless, tasteless powder. mp 1670°. d 3.14. Practically insol in water, alcohol or acetic acid; sol in dil HCl or HNO_3.

USE: Manuf of fertilizers, H_3PO_4 and P compds; manuf milk-glass, polishing and dental powders, porcelains, pottery; enameling; clarifying sugar syrups; in animal feeds; as noncaking agent; in the textile industry.

THERAP CAT: Calcium replenisher.

THERAP CAT (VET): Has been used as a dietary supplement, and as an antacid.

1696. Calcium Phosphide. Photophor. Ca_3P_2; mol wt 182.20. Ca 65.99%, P 34.01%. Prepn: Ehrlich in *Handbook of Preparative Inorganic Chemistry,* **vol. 1,** G. Brauer, Ed. (Academic Press, New York, 2nd ed., 1963) p 943.

Red-brown cryst powder or gray lumps. Dec by moist air or water, evolving spontaneously-flammable phosphine. d 2.51; mp about 1600°. *Keep dry and tightly closed.*

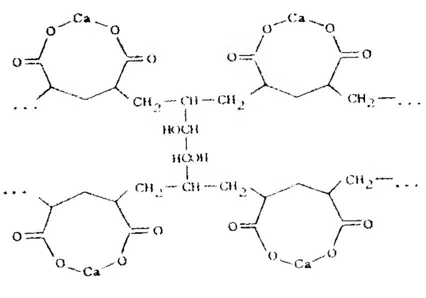
USE: For signal fires; in purification of Cu and Cu alloys; as rodenticide.

1697. Calcium Phosphite. $CaHO_3P$; mol wt 120.07. Ca 33.38%, H 0.84%, O 39.98%, P 25.80%. $CaHPO_3$. Prepn: *Gmelin's, Calcium* (8th ed.) **28B,** 1121 (1958).

Monohydrate, crystals. Loses water at 200°; dec above 300°. Slightly sol in water; practically insol in alcohol.

USE: Fertilizers; polymerization catalyst.

1698. Calcium Polycarbophil. Carbofil; Quival. Calcium salt of a synthetic loosely crosslinked hydrophilic resin of the polycarboxylic type. Commercial development: White Laboratories.



THERAP CAT: Antidiarrheal.

1699. Calcium Propionate. *Propionic acid calcium salt;* Mycoban. $C_6H_{10}CaO_4$; mol wt 186.22. C 38.70%, H 5.41%, Ca 21.52%, O 34.37%. $Ca(CH_3CH_2COO)_2$. Occurs as mono- or trihydrate. Prepn: *Beilstein* **vol. 2,** 238, 2nd suppl., 218, 3rd suppl., 516.

Powder or monoclinic crystals. Sol in water; slightly sol in methanol, ethanol; practically insol in acetone, benzene.

USE: As an inhibitor of molds and other microorganisms in foods, tobacco, pharmaceuticals; in butyl rubber to improve processability and scorching resistance.

THERAP CAT: Antifungal.

1700. Calcium Pyrophosphate. Calcium diphosphate. $Ca_2O_7P_2$; mol wt 254.12. Ca 31.54%, O 44.08%, P 24.38%. $Ca_2P_2O_7$. Prepn by ignition of $CaHPO_4$: St. Pierre, *J. Am. Chem. Soc.* **77,** 2197 (1955).

Polymorphous crystals or powder. d 3.09. mp 1353°. Practically insol in water; sol in dil HCl or HNO_3.

USE: Abrasive, fertilizer; feed supplement; in dentifrices, ceramic ware, china, glass, phosphors.

1701. Calcium D-Saccharate. *D-Glucaric acid calcium salt.* $C_6H_8CaO_8$; mol wt 248.21. C 29.03%, H 3.25%, Ca 16.15%, O 51.57%. $CaC_6H_8O_8$. The normal calcium salt of D-saccharic acid, a dicarboxylic sugar acid derived from the oxidation of D-gluconic acid. Calcium D-saccharate is a true chemical compd and should not be confused with saccharated lime, formerly called "calcium saccharate" and produced by the action of lime upon sugar. Prepn: *Beilstein,* **vol. 3,** 2nd suppl., 378; *Hagers Handb. Pharm. Praxis* **vol. 1,** 755 (Berlin, 1930).

Tetrahydrate, odorless, tasteless crystals or fine white powder. Stable to air. Becomes anhydr upon heating at 100° *in vacuo.* Practically insol in water, alcohol, ether. Sol in dil mineral acids and in calcium gluconate solns.

USE: As plasticizer in cement, concrete, mortar.

THERAP CAT: Pharmaceutic aid (stabilizer for calcium gluconate solns).

1702. Calcium Salicylate. *2-Hydroxybenzoic acid calcium salt.* $C_{14}H_{10}CaO_6$; mol wt 314.30. C 53.50%, H 3.21%, Ca 12.75%, O 30.54%. $Ca[C_6H_4(OH)COO]_2$. Prepn: Coninck, *Rec. Gen. Chim.* **17,** 72 (1914).

Dihydrate, monoclinic crystals or powder. Odorless; tasteless. Loses all H_2O at 120°. Decomposes at 244° to phenol, the basic salicylate, CO_2 and H_2O. Soly in water (15.5°): 28.46 g/l; soly in ethanol (16.7°): 15.5 parts/l; slightly sol in methyl acetate; sol in methanol. The aq soln is slightly acid and light sensitive.

1703. Calcium Selenate. CaO_4Se; mol wt 183.04. Ca 21.90%, O 34.97%, Se 43.14%. $CaSeO_4$. Prepn: Mitscherlich, *Pogg. Ann.* **9,** 623 (1827); von Hauer, *Sitzungsber. Akad. Wien* **39,** 299, 839 (1860); Lehner, Kao, *J. Am. Chem. Soc.* **47,** 1521 (1925).

Dihydrate, monoclinic crystals. d_4^{20} 2.69. Gradually loses H_2O on heating becoming anhydr by 200°; dec to $CaSeO_3$ at 698°. Sol in water.

USE: Pesticide.

1704. Calcium Selenide. CaSe; mol wt 119.04. Ca 33.67%, Se 66.33%. Prepd by reducing $CaSeO_4$ in a stream of H_2 at 400-500°: Ehrlich in *Handbook of Preparative Inorganic Chemistry,* **vol. 1,** G. Brauer, Ed. (Academic Press, New York, 2nd ed, 1963) p 939.

White powder. In air may turn red within a few minutes and light brown in a few hours. d 3.82. Decomposed by water. Treatment with HCl produces H_2Se gas, and red Se separates.

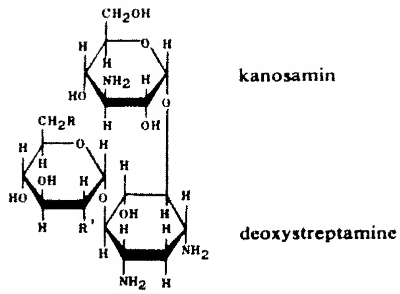
USE: In electron emitters.

1705. Calcium Silicate. Many different forms of calcium silicate are known. Among the most common forms are $CaSiO_3$, Ca_2SiO_4 and Ca_3SiO_5. Usually occur in hydrated form contg various percentages of water of crystallization. Names of calcium silicate minerals are: *afwillite; akermannite; calcium pectolith; centrallasite; crestmoreite; eaklite; foshagite; foshallasite; gjellebaekite; grammite; gyrolite; hillebrandite; larnite; okenite; parawollastonite; pseudo-wollastonite; riversideite; table spate; tobermorite; wollastonite; xonaltite; xonotlite.* Commercial calcium silicate sold for industrial use, such as *Micro-Cell* and *Silene,* is prepared synthetically to control its absorbing power. The usual method of prepn is from lime and diatomaceous earth under carefully controlled conditions: Boss, *Chem. Eng. News* **27,** 677 (1949); Steinour, *Chem. Revs.* **40,** 391 (1947). The commercial product is described here.

White or slightly cream-colored, free-flowing powder. Approximate analysis: CaO 19%, SiO_2 67%, H_2O 6 to 8%. d^{25} 2.10. Bulk density: 15 to 16 lb/cu ft. Absorbs 1 to 2.5 times its weight of liquids and still remains a free-flowing powder. Total absorption power for water about 600%, for mineral oil about 500%. Available surface area: 95 to 175 m^2/g. Ultimate particle size: 0.02 to 0.07 μ. pH of aq slurry 8.0 to 10.0. Practically insol in water. Forms a siliceous gel with mineral acids.

USE: Constituent (produced *in situ*) of lime glass, portland cement; reinforcing filler in elastomers and plastics; absorbent for liquids, gases, vapors; as anti-caking agent, suspension agent, pigment and pigment extender; binder for refractory material; in chromatography; in road construction.

1706. Calcium Stearate. *Octadecanoic acid calcium salt; stearic acid calcium salt.* $C_{36}H_{70}CaO_4$; mol wt 607.00. C



Kanamycin A, $C_{18}H_{36}N_4O_{11}$. R = NH_2; R′ = OH. Crystals from methanol + ethanol. $[\alpha]_D^{24}$ +146° (0.1 *N* H_2SO_4). LD_{50} i.v. in mice: 583 mg/kg.

Kanamycin A sulfate, ***Cantrex, Cristalomicina, Kamycin, Kamynex, Kanacedin, Kanamytrex, Kanasig, Kanicin, Kannasyn, Kantrex, Kantrox, Otokalixin, Resistomycin (Bayer), Ophtalmokalixan, Kantrexil, Kano, Kanescin, Kanaqua.*** (U.S.P. requires that kanamycin sulfate contains not less than 75% kanamycin A and not more than 5% kanamycin B sulfate on an anhydr basis.) Irregular prisms, dec over a wide range above 250°C. Freely sol in water; practically insol in the common alcohols and nonpolar solvents. LD_{50} in mice: 20.7 g/kg orally; 1450 mg/kg i.p., Zel'tser *et al.*, *Antibiotiki* **19**, 552 (1974).

Kanamycin B, $C_{18}H_{37}N_5O_{10}$, ***NK 1006, bekanamycin, aminodeoxykanamycin.*** R = R′ = NH_2. Crystals, mp 178-182° (dec). $[\alpha]_D^{18}$ +130° (c = 0.5 in water). $[\alpha]_D^{21}$ +114° (c = 0.98 in water). Soluble in water, formamide; slightly sol in chloroform, isopropyl alcohol; practically insol in the common alcohols and nonpolar solvents. LD_{50} i.v. in mice: 136 mg/kg.

Kanamycin B sulfate, ***Kanendomycin.***

Kanamycin C, $C_{18}H_{36}N_4O_{11}$. R = OH; R′ = NH_2. Crystals from methanol + ethanol, dec above 270°. $[\alpha]_D$ +126° (H_2O). Sol in water; slightly sol in formamide. Practically insol in the common alcohols and nonpolar solvents.

THERAP CAT: Antibacterial.

5133. Kaolin. Bolus alba; China clay; porcelain clay; white bole; argilla. Essentially a hydrated aluminum silicate, approximately $H_2Al_2Si_2O_8.H_2O$. Prepared for pharmaceutical and medicinal purposes by levigating with water to remove sand, etc.

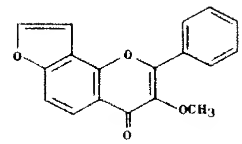
White or yellowish-white, earthy mass or white powder; unctuous when moist. Insol in water, cold acids or in alkali hydroxides.

USE: Manuf porcelain, pottery, bricks, Portland cement; ultramarine, color lakes, refractory mortar; plaster material, filler for paper; electric and heat insulators; clarifying liquids; drying and emollient agent.

THERAP CAT: Adsorbent.

THERAP CAT (VET): Topical and G.I. adsorbent. Poultice.

5134. Karanjin. *3-Methoxy-2-phenyl-4H-furo[2,3-h]-1-benzopyran-4-one.* $C_{18}H_{12}O_4$; mol wt 292.28. C 73.96%, H 4.14%, O 21.90%. From *Pongamia glabra* Vent., *Leguminosae:* Beal, Katti, *J. Am. Pharm. Assoc.* **14**, 1086 (1925); Rao, Rao, *J. Indian Chem. Soc.* **17**, 526 (1940); Bhat *et al.*, *J. Am. Oil Chem. Soc.* **33**, 197 (1956). Structure: Limaye, *Rasayanam* **1**, 1 (1936), *C.A.* **31**, 2206[9] (1937); Manjunath *et al.*, *Ber.* **72B**, 39 (1939). Synthesis: Seshadri, Venkateswarlu, *Proc. Indian Acad. Sci.* **13A**, 404 (1941); **17A**, 16 (1943); Kawase *et al.*, *Bull. Chem. Soc. Japan* **28**, 273 (1955); Rao, Seshadri, *Proc. Indian Acad. Sci.* **33A**, 168 (1951); Aneja *et al.*, *Tetrahedron* **2**, 203 (1958); Raizada *et al.*, *J. Sci. Ind. Res.* **19B**, 76 (1960).



Needles from methanol, mp 157-158°. Sol in methanol, ethanol, chloroform, benzene, ether, concd H_2SO_4, HNO_3, HOAc, HCl; practically insol in petr ether, dil mineral acids.

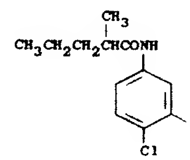
5135. Karaya Gum. Gum karaya; kadaya; katilo; kullo; kuteera; sterculia; Indian tragacanth; mucara. The dried exudate of the tree *Sterculia urens* Roxb., *Sterculiaceae*, found in India, especially in the Gujerat region and in the central provinces: Toothaker, *The Soluble Gums* (Philadelphia, 1921); Mantell, *The Water-Soluble Gums* (New York, 1947). Constituents and structure: Hirst, Dunstan, *J. Chem. Soc.* **1953**, 2332. Structure is a partially acetylated polysaccharide containing about 8% acetyl groups and about 37% uronic acid residues. *Reviews:* F. Smith, R. Montgomery, *The Chemistry of Plant Gums and Mucilages* (Reinhold, New York, 1959); Goldstein, Alter, in *Industrial Gums*, R. L. Whistler, Ed. (Academic Press, New York, 2nd ed., 1973) pp 273-287.

Finely ground white powder, faint odor of acetic acid. Acid to litmus. Absorbs water rapidly to form viscous mucilages at low concs. Viscosity decreases on addn of acid or alkali. Color of the soln lightens in acidic media and darkens in alkaline soln due to the presence of tannins. Gum karaya loses viscosity forming ability when stored in the dry state, the loss being greater for a powdered material than for the crude gum. Cold storage inhibits this degradation.

USE: As denture adhesive; as binder in paper manuf; as meringue stabilizer; as thickening agent for dyes in textile industry. A substitute for gum tragacanth.

THERAP CAT: Cathartic.

5136. Karsil. *N-(3,4-Dichlorophenyl)-2-methylpentanamide; 3′,4′-dichloro-2-methylvaleranilide;* Niagara 4562. $C_{12}H_{15}Cl_2NO$; mol wt 260.17. C 55.40%, H 5.81%, Cl 27.26%, N 5.38%, O 6.15%. Prepd from 3,4-dichloroaniline and 2-methylvaleryl chloride: Dorschner *et al.*, **Brit. pat. 869,169** (1961 to FMC).



Crystals, mp 106-107°.

USE: Herbicide.

5137. Katonium. A brand of sodium-adsorbent exchange resin; styronate resin, made from ammonium polystyrene sulfonate 75%, and potassium polystyrene sulfonate 25% [Winthrop-Stearns].

THERAP CAT: Ion exchange resin (sodium adsorption).

5138. Kava. Kava-kava; ava-ava; kawa. Dried rhizome and roots of *Piper methysticum* Forst., *Piperaceae*. *Habit.* Polynesia. Most important constituents are: kawain, dihydrokawain, methysticin, dihydromethysticin, and yangonin: Borsche, Lewinsohn, *Ber.* **66**, 1792 (1933) and references to preceding papers therein. Chemical and pharmacological investigation of the kava constituents: Klohs *et al.*, *J. Med. Pharm. Chem.* **1**, 95 (1959); Meyer, Kretzschmar, *Klin. Wochenschr.* **44**, 902 (1966). Review of chemistry, pharmacology and historical sketch: *U.S. Public Health Service Publ. No. 1645*, D. H. Efron, Ed., pp 103-181 (1967).

Note: Kava is also the popular name for the intoxicating drink prepared from the plant's roots.

5139. Kawain. *(R)-5,6-Dihydro-4-methoxy-6-(2-phenylethenyl)-2H-pyran-2-one;* 5-hydroxy-3-methoxy-7-phenyl-2,6-heptadienoic acid δ-lactone; 4-methoxy-6-(β-phenyl-

e fluffy powder. d^{20}
t 1100-1200°. Soly in
acids. With hydro-
$LiHF_2$. With lithium
LiOH, mp 462°. LD

ing aluminum, in the
s. Lithium fluoride
tometers.

; mol wt 51.96. C
%. HCOOLi
tals. d 1.46. Sol in 3
neutral.

wt 7.95. H 12.70%,
ombination of hydro-
hem. Soc. **93**, 198-211
s: Truter in *Mellor's*
tals (part 1) 131-145

exposure to light, the
np 680°. d 0.76-0.77.
vater to form lithium
h the lower alcohols,
nia at 400° to liberate

gent with ketones and
nerators; 1 g in water
at STP.

hydrate. HLiO; mol
80%. LiOH. Prepn:
hen, *Inorg. Syn.* **5**, 3
w of prepn, properties
, supplement II, *The*

id, strongly alkaline.
ur. d 2.54. mp 471°.
Keep tightly closed.
stals. d_4^{20} 1.51. Heat
Heat of soln 0.87
at 0°: 10.7%; at 20°:
alcohol. pH of a 1.0 *N*

alkaline storage bat-
here use of carbonate
uction of alkyd resins,
ithium soaps, greases,
ne and hence caustic.
icity similar to other

wt 181.84. I 69.79%,

crystals. Sol in 1.5
ell closed.

133.83. I 94.82%, Li

s or fused masses; be-
o liberation of iodine.
about 0.5 part water
cetone. The aq soln is
ly closed and protected

mol wt 68.95. Li

3. mp about 255°. Sol
The aq soln is neutral.

; mol wt 101.88. C
O_4.
parts water.

t 29.88. Li 46.45%, O
Cohen, *Inorg. Syn.* **5**,
avo, *ibid.* **7**, 3 (1963).
er in *Mellor's* **vol. II**,
rt 1) 146-158 (1961).

Finely divided powder or crusty material. d_4^{25} 2.013. mp 1570°: van Arkel *et al., Can. J. Chem.* **31**, 1009 (1953); 1427° (1700°K): Brewer, Margrave, *J. Phys. Chem.* **59**, 421 (1955). Readily absorbs carbon dioxide and water from the atm. At elevated temp attacks glass, silica, many metals.

5377. Lithium Perchlorate. $ClLiO_4$; mol wt 106.40. Li 6.52%, Cl 33.33%, O 60.15%. $LiClO_4$.
Small crystals. d_4^{25} 2.43. mp 236°. Decompn starts at about 400° and becomes rapid at 430° yielding lithium chloride and oxygen. Heat of formation: −99.94 kcal/mol at 25°. Soly in water (w/w) at 0°: 29.9%; at 25°: 37.5%; at 100°: 71.5%. Appreciably sol in alcohol, acetone, ether, ethyl acetate.
USE: Oxidizing agent. *Caution:* May be irritating on contact with skin, mucous membranes.

5378. Lithium Phosphate. Li_3O_4P; mol wt 115.76. Li 17.98%, O 55.27%, P 26.75%. Li_3PO_4.
Hemihydrate, white, cryst powder. Sol in about 2500 parts water; sol in dil acids.

5379. Lithium Rubidium Tetracyanoplatinate(II). Platinous lithium rubidium cyanide. C_4LiN_4PtRb; mol wt 391.58. C 12.26%, Li 1.77%, N 14.31%, Pt 49.84%, Rb 21.82%. $LiRbPt(CN)_4$. (Contains a variable quantity of water.)
Greenish-yellow, cryst needles. Soluble in water. More strongly fluorescent in x-rays than platinum barium cyanide; hence used instead of the latter in fluoroscopy.

5380. Lithium Selenate. LiO_4Se; mol wt 149.90. Li 4.63%, O 42.70%, Se 52.67%. Prepd by roasting lithium selenite in air or by roasting lithium carbonate with selenium or selenium oxide: Lenher, Wechter, *J. Am. Chem. Soc.* **47**, 1522 (1925).
Monohydrate, monoclinic crystals. d 2.565. *Poisonous!* Stable in air. Readily sol in water.

5381. Lithium Selenite. LiO_3Se; mol wt 133.90. Li 5.18%, O 35.85%, Se 58.97%. $LiSeO_3$. Prepd from a soln of selenious acid in lithium hydroxide at 60°: Nilson, *Bull. Soc. Chim.* [2] **21**, 253 (1874); *ibid.* [2] **23**, 262 (1875).
Monohydrate, acicular crystals. Hygroscopic. More sol in cold water than in hot water.

5382. Lithium Silicate. Lithium metasilicate. Li_2O_3Si; mol wt 89.97. Li 15.43%, O 53.35%, Si 31.22%. Li_2SiO_3. Prepd by fusing Li_2CO_3 with SiO_2: Schwarz, Sturm, *Ber.* **47**, 1737 (1914).
Orthorhombic needles. d_4^{25} 2.52. mp 1201°. Heat of formation (solid): −434.9 kcal/mol. Heat of formation (liq): −374.6 kcal/mol. Latent heat of fusion (1177°) = 7.24 kcal/mol, also reported as −80.2 cal/g. Insol in cold water, dec by boiling water, dilute hydrochloric acid.
USE: To calibrate thermoelements.

5383. Lithium Sulfate. Lithiophor; Lithium-Duriles. Li_2O_4S; mol wt 109.88. Li 12.63%, O 58.25%, S 29.12%. Li_2SO_4.
Monohydrate, colorless crystals; loses the water at 130°. d 2.06. Sol in 2.6 parts water; almost insol in alcohol. The aq soln is neutral.
THERAP CAT: Antidepressant.

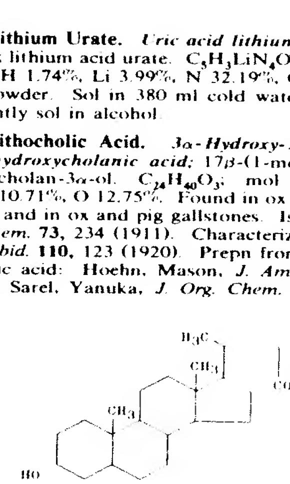
5384. Lithium Tartrate. $C_4H_4Li_2O_6$; mol wt 161.95. C 29.66%, H 2.49%, Li 8.59%, O 59.28%.
Monohydrate, white, cryst powder. Sol in water. The aq soln is neutral or slightly alkaline to litmus.

5385. Lithium Tetracyanoplatinate(II). Platinous lithium cyanide; lithium platinocyanide. $C_4Li_2N_4Pt$; mol wt 313.04. C 15.35%, Li 4.43%, N 17.90%, Pt 62.32%. $Li_2Pt(CN)_4$.
Pentahydrate, greenish-yellow crystals. Slightly sol in water.
USE: In x-ray photography.

5386. Lithium Thiocyanate. Lithium sulfocyanate. CLiNS; mol wt 65.02. C 18.47%, Li 10.67%, N 21.54%, S 49.31%. LiSCN.
White, deliquesc crystals. Freely sol in water or alcohol. *Keep well closed.*

5387. Lithium Urate. *Uric acid lithium derivative;* lithium biurate; lithium acid urate. $C_5H_3LiN_4O_3$; mol wt 174.05. C 34.50%, H 1.74%, Li 3.99%, N 32.19%, O 27.58%.
White powder. Sol in 380 ml cold water, 39 ml boiling water; slightly sol in alcohol.

5388. Lithocholic Acid. *3α-Hydroxy-5β-cholan-24-oic acid; 3α-hydroxycholanic acid;* 17β-(1-methyl-3-carboxypropyl)etiocholan-3α-ol. $C_{24}H_{40}O_3$; mol wt 376.56. C 76.55%, H 10.71%, O 12.75%. Found in ox bile, human bile, rabbit bile, and in ox and pig gallstones. Isoln: Fischer, *Z. Physiol. Chem.* **73**, 234 (1911). Characterization: Wieland, Weyland, *ibid.* **110**, 123 (1920). Prepn from cholic or from desoxycholic acid: Hoehn, Mason, *J. Am. Chem. Soc.* **62**, 569 (1940); Sarel, Yanuka, *J. Org. Chem.* **24**, 2018 (1959).



Hexagonal leaflets from alcohol, prisms from acetic acid, mp 184-186°. $[\alpha]_D^{20}$ +33.7° (c = 1.5 in abs ethanol); $[\alpha]_D^{19}$ +23.3° (Wieland); $[\alpha]_D^{20}$ +32.1° (Fischer). Freely sol in hot alc. More sol in ether than cholic or desoxycholic acid. Sol in about 10 times its weight of ethyl acetate. Slightly sol in glacial acetic acid (about 0.2 g in 3 ml). More sol in benzene than desoxycholic acid. Insol in petr ether, gasoline, ligroin, water.
Methyl ester, $C_{25}H_{42}O_3$, crystallizes with ½ mol methanol, mp 125-127°.
Ethyl ester, $C_{26}H_{44}O_3$, crystals, mp 92-93°.
Benzyl ester, $C_{31}H_{46}O_3$, crystals, mp 145-148°.
Acetyllithocholic acid, $C_{26}H_{42}O_4$, crystals, mp 169°.
Acetyllithocholic acid methyl ester, $C_{27}H_{44}O_4$, flat needles from pentane, mp 123-130°.
Acetyllithocholic acid ethyl ester, $C_{28}H_{46}O_4$, crystals, mp 90-91°.

5389. Lithopone. Griffith's zinc white. A white pigment consisting of a mixture of zinc sulfide, barium sulfate and some zinc oxide. Made by pptn of $ZnSO_4$ with BaS and heating.

5390. Litmocidin. Antibiotic substance produced by *Proactinomyces cyaneusantibioticus.* Isoln: Gause, *J. Bacteriol.* **51**, 649 (1946); Brazhnikova, *ibid.* 655; Abou-Zeid, El-Gammal, *Z. Allg. Mikrobiol.* **11**, 5 (1971). Belongs to the class of pigments and shows same qualitative reactions as anthocyanidine: Brazhnikova, *C.A.* **41**, 5576h (1947). Approx mol wt of 398-418: Paskhina, *Biokhimiya* **21**, 448 (1956).

5391. Litmus. Lacmus; tournesol; turnsole; lacca musica; lacca coerulea. Mol wt about 3300. Blue coloring matter from various species of lichens, particularly *Variolaria, Lecanora,* and *Rocella. Habit.* Scandinavia, shores of Mediterranean, Azores, California, East India, Madagascar. *Constit.* Chiefly azolitmin and erythrolitmin combined with alkalies: lecanoric acid, orcein, erythrolein. Manuf almost exclusively in Holland. Structure studies: Beecken *et al., Angew. Chem.* **73**, 665 (1961). Contains in small amounts α,β,γ-amino and hydroxyorcein.
Blue powder, lumps or cubes. Partly soluble in water or alcohol.
USE: As acid-base indicator; pH: 4.5 red, 8.3 blue. For preparing litmus papers; in microscopy to color culture media for diagnostic purposes. Has been used for coloring beverages.

5392. Liver Extract. An extract made from the livers of mammals. Upon ingestion or injection in a suitable dosage form it increases the number of red blood corpuscles in the blood of persons afflicted with pernicious anemia. Contains folic acid and vitamin B_{12} activity.
Some commercial products are: ***Intraheptol; Pernaemon;***